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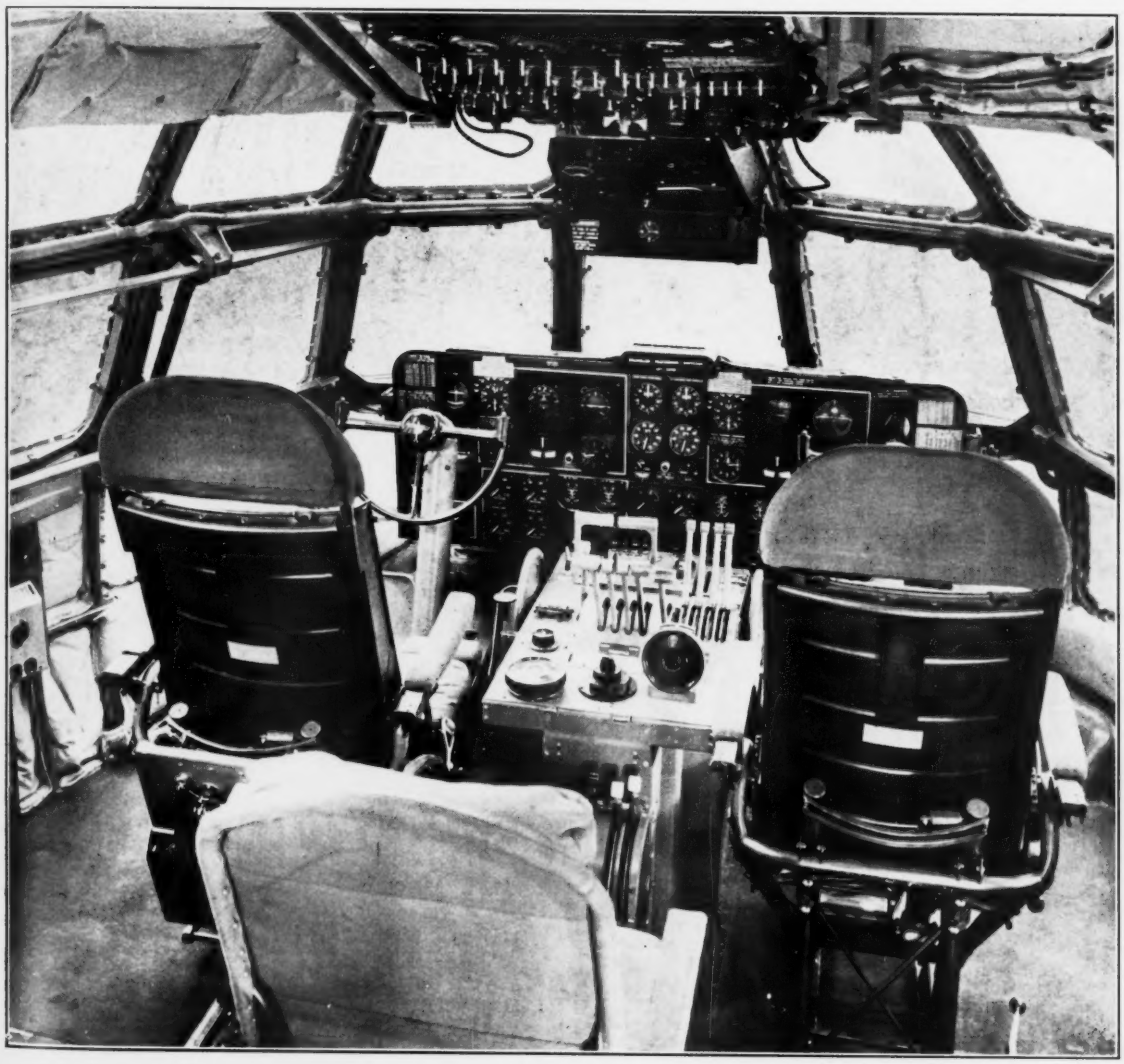
AERONAUTICAL ENGINEERING REVIEW

FEBRUARY 1946



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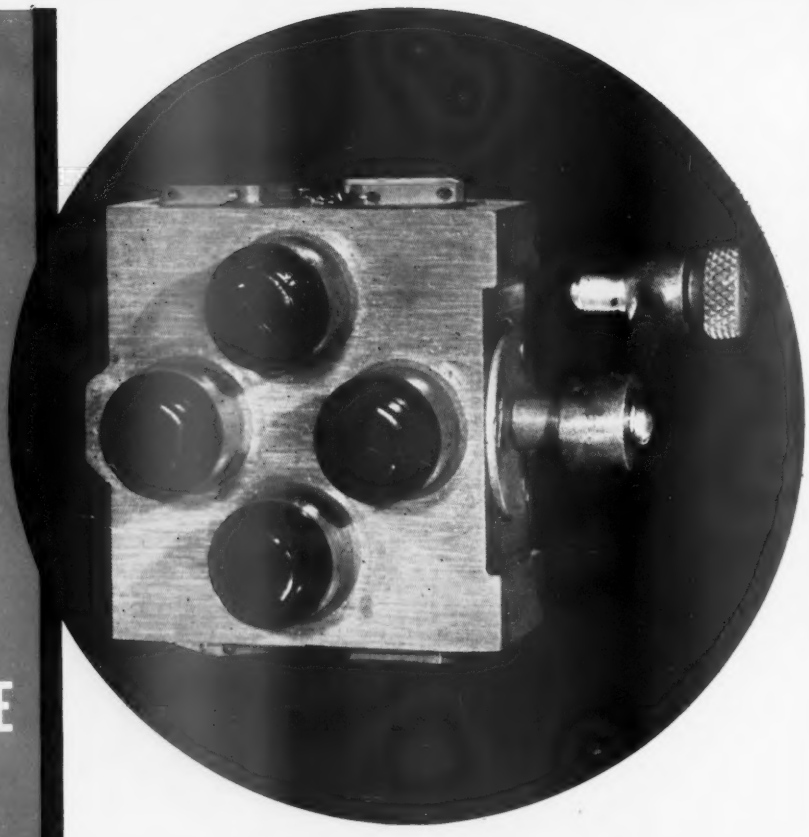

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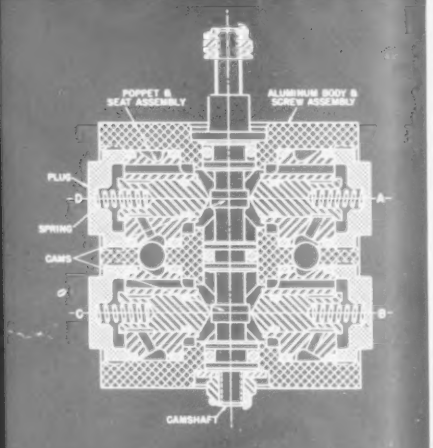

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after 1659 hours ON A DOUGLAS C-54

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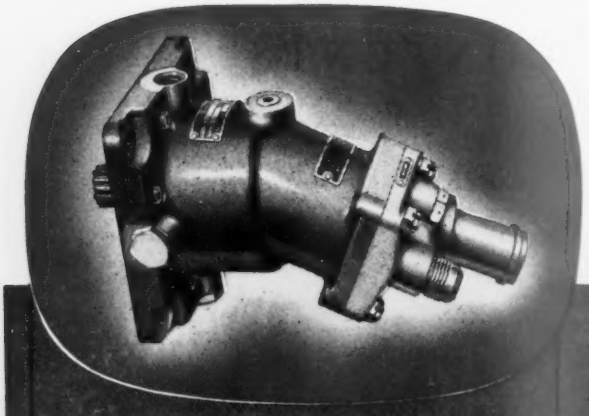

	PERFORMANCE REQUIREMENTS of Series PF-3911 Pumps at Factory	ACTUAL TEST PERFORMANCE of a PF-3911 Pump After 1659 Hours Flight Time On C-54
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SINCE 1921

Armament for Jet-Propelled Bombardment Airplanes

R. A. AVERITT*

General Electric Company

Introduction

THE ADVENT OF JET PROPULSION ENGINES for aircraft has so changed military airplane performance as to necessitate a completely new approach to the problem of accessory design.

In the case of bombardment airplanes powered by jet propulsion, the defensive armament reaches new importance. Not only is the general problem of defense more complex than in present conventional airplanes, but also the armament must contribute an absolute minimum of weight and drag to the airplane.

Although bombardment airplane defensive armament has undergone rapid and intensive development during recent years, the ultimate has by no means been reached. Continued research and development in all phases is required for successful armament application to jet-propelled airplanes. This development must be carefully integrated with the design of the airplane itself to the end that a wholly effective military tool—airplane and armament—will be obtained.

General

One of the most controversial subjects in connection with bombardment airplanes is that of defensive armament. Several different conceptions of the purpose of defensive armament exist, and for any given airplane there are many different theories as to the type and amount of defensive armament that should be installed. Many of these theories are well-founded, based on up-to-date battle experience, and range from a concept of little or no armament at all to one approaching a point where the airplane is so heavily armed that it is incapable of carrying any appreciable load of bombs on one mission.

In considering the general problem of bomber defense, it might be well to attempt a definition of the purpose of defensive armament. For this discussion, let it be considered that the purpose of defensive armament is to protect adequately the airplane and its crew to the extent of insuring a better-than-even probability that the airplane will survive during any one complete mission. This definition is somewhat loose but, in general, contrasts with the philosophy of armament designed to provide support fire for formation tactics or one

designed to eliminate a maximum number of enemy fighters whether or not they are attacking.

To design armament fulfilling this objective, it is necessary to give consideration to a number of different factors. Some of these are:

(a) Size of bomber.
(b) Gross weight.
(c) Maximum and cruising speeds.
(d) Operational altitude.
(e) Operational range.
(f) Type of mission (day or night).
(g) Probable type of fighter opposition to be encountered.

These factors are constantly changing, of course, as progress is made in both bombardment and fighter airplanes, necessitating improvement and innovations in bomber defense. There are many examples of this; one of the most familiar is the case of the B-17.

Growth

In its early version the B-17 was named and believed to be a "Flying Fortress." The defensive armament consisted of five hand-held 0.50-cal. machine guns located in the nose and waist to provide coverage from nose, beam, upper, and lower attacks. However, many blind spots existed and coverage was obtained in most areas by only one gun. In subsequent models, armament was added as a result of battle experience; and in its latest model, the B-17H includes three power-operated, dual 0.50-cal. turrets, one manually operated dual 0.50-cal. tail mount, and five hand-held guns. The B-24 airplane has gone through a similar evolution.

In later airplanes, for example the B-29, a vast amount of thought and effort has been given to the armament problem. For the first time an attempt was made to design the defensive armament as a complete system providing a maximum of protection with a minimum of additional weight and drag imposed upon the airplane. This effort has resulted in turrets remotely controlled from optical sighting stations so located in the airplane to provide a maximum of sighted fire coverage and flexibility of defense. In addition, computers are employed in the system to provide corrected gun bearing due to ballistics, lead, and parallax. Yet the B-29 system is by no means static in its form. A number of improvements have been made since the first B-29's went to combat and numerous others that are planned for the future have come about because of changes in those factors previously mentioned.

Jet-Propelled Airplanes

The entire history of military aviation has been characterized by a search for more powerful engines, to enable airplanes to carry heavier loads farther, faster, and higher. Undoubtedly, the most significant development to date in this direction is the jet propulsion engine. With it, airplanes may far exceed the bounds of altitude and speed which have been imposed with reciprocating engines. The limits of speed have been so broadened as to necessitate a completely new line of approach to the solution of the armament problem.

The jet propulsion engine inherently implies high airplane speeds. The efficiency of a jet engine does not surpass that of propeller drive until a speed of approximately 500 m.p.h. is reached. This, of course, is in a region where compressibility effects start to become important. Therefore, in order to effectively utilize the potentialities of jet propulsion, it is essential that the airplane be kept aerodynamically clean.

Heretofore the addition of a bump or blister to the profile of an airplane has been considered feasible, and, in some cases, well worth the resultant drag. In the case of a jet-propelled airplane, however, any significant protrusion may well have such detrimental effect to the total airplane performance as to render the airplane useless for its purpose. Consequently, the armament must, to the fullest extent possible, be located within the skin line of the airplane. It is impractical to consider turrets and

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* Aviation Division.

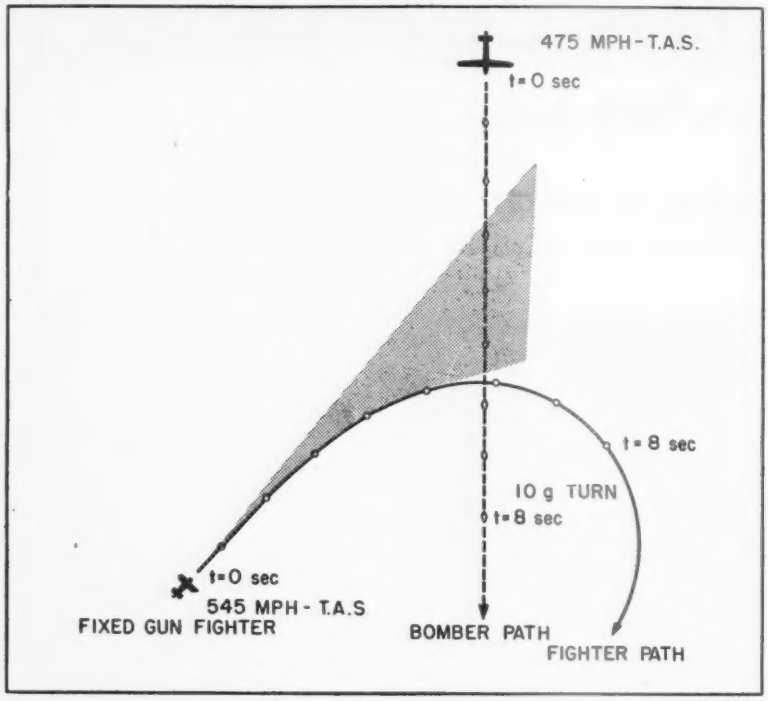

Fig. 1.

sights located on the top, bottom, or sides of the airplane which protrude beyond the normal skin line. Even 8 or 10 in. of gun barrel, without any dome, extending beyond the skin line and normal to the direction of flight, will introduce excessive drag. This is due to the fact that drag is proportional to the product of drag coefficient and the square of the velocity. In the case of a gun barrel, the coefficient of drag increases quite rapidly at high Mach Numbers.

With this in view, it is evident that the defensive armament for jet-propelled airplanes can no longer be considered as a number of dissociated components added from time to time in random fashion. Instead, the armament must be considered as an integral system designed to fulfill a specific purpose for a specific airplane. This necessitates that the armament system design be carried on concurrently with that of the basic airplane from the preliminary design stage to the final production design.

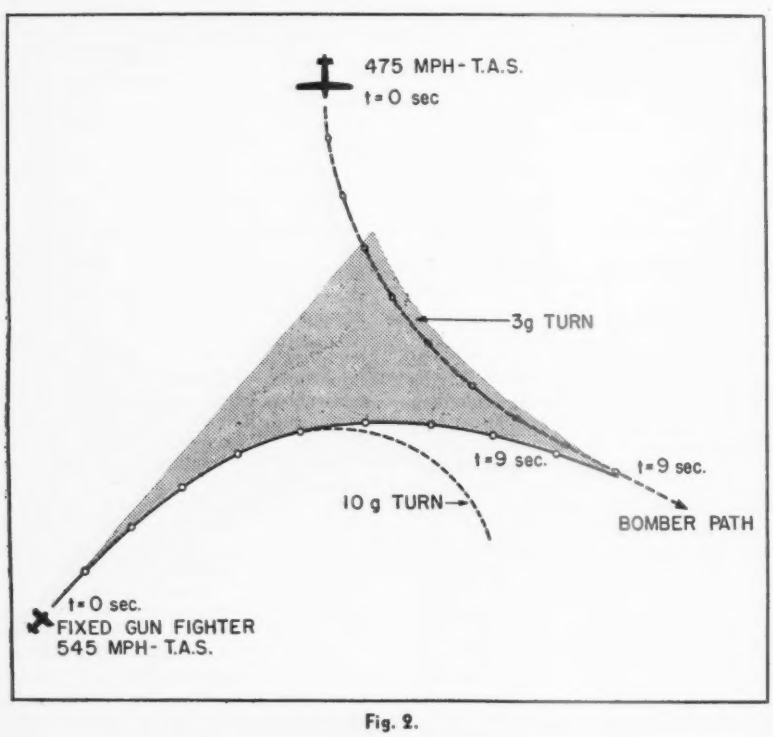

Fig. 2.

A Specific Airplane

A brief analysis of a purely hypothetical bombardment airplane should be helpful in outlining the various considerations necessary in the design of an armament system. Let it be assumed that an airplane is contemplated having the following characteristics:

Type—Bombardment
Maximum gross weight—120,000 lbs.
Engines—Four jet propulsion units
Speed—Maximum speed performance at approximately 0.72 Mach Number
Service ceiling—50,000 ft.
Range—3,500 miles
Crew—Four
Cabin—Pressurized

While these data define the bombardment airplane, they are insufficient to define the defensive armament problem completely. It is also necessary to estimate the type of enemy opposition that may be encountered. Let it be assumed, therefore, that these fighters will also be jet propelled, and below 50,000 ft. will be capable of operating at approximately 0.82 Mach Number. This represents a speed differential of approximately 70 m.p.h. in favor of the fighter over the bomber, if both are operating at their assumed maximum speeds. Let it also be assumed that within normal limits of maneuverability the bomber will be capable of pulling 3g turns in any direction and the fighter will be able to pull 10g turns.

With these data it is now possible to analyze the different kinds of attacks which can be made. It is evident that with speed superiority the fighter can make tail attacks. It may be contended, however, that nose attacks are not feasible from the fighter, because of the high relative closing speed, which would be approximately 1,020 m.p.h., or approximately 1,500 ft. per sec. Such an attack condition is shown in Fig. 1 where the fighter initiates his attack from 1 o'clock at a range of approximately 2,500 yards. The shaded portion represents the area where the fighter can fire his forward-firing fixed guns with the proper lead to hit the bomber. The calculations have been based on 0.50-cal. ballistics and within the accuracy of the plot will hold approximately for 20-mm. ballistics. Assuming that the bomber takes no evasive action, it is shown that the fighter can fire for approximately 2 sec. before starting his 10g turn.

Admittedly, the problem for the fighter would be difficult because of the high lead rates involved; however, it is assumed that the fighter's offensive armament is capable of solving the

problem. In such an attack, nose protection for the bomber would be advantageous.

Fig. 2 shows the same kind of attack development except that the bomber is turning away from the attacking fighter in a 3*g* turn. This maneuver is disadvantageous for the bomber because, as the attack develops, the fighter is able to rake the bomber throughout its turn to end up on its tail without going to the limit of a 10*g* turn. Here again, it would be advantageous for the bomber to be able to protect itself in the nose hemisphere.

Fig. 3 shows the same kind of attack development, the fighter at 1 o'clock, 2,500 yards range, except with the more conventional case of the bomber turning into the fighter path in a 3*g* turn. This type of maneuver limits the firing time of the fighter to less than 2 sec. before breakaway is started.

Fig. 4 represents the same type of maneuver as Fig. 3 except that in this case the fighter is assumed to have a nose turret capable of a 60° cone of fire symmetrically disposed about the airplane centerline. Under this condition, the fighter is no longer restricted to a curve of pursuit in order to get hits on the bomber but can fly any course that will permit the turret to bear in such a direction as to obtain hits. The flight path of the fighter shown in Fig. 4 was determined arbitrarily and permits slightly more than 3 sec. of firing before the fighter goes into a 10*g* turn. Five and one-half seconds later, however, the fighter will again be in position to fire on the bomber at a range of approximately 2,000 yards. Many types of attacks are possible from a turreted fighter, which would be disastrous to a bomber equipped with only tail protection. Depending upon the fighter's turret coverage, it would be entirely possible to fly a course parallel to the bomber at short range and out of the bomber's tail turret zone and deliver lethal fire at a relatively stationary target. The bomber's only defense in this case would be maneuverability, which would not be effective.

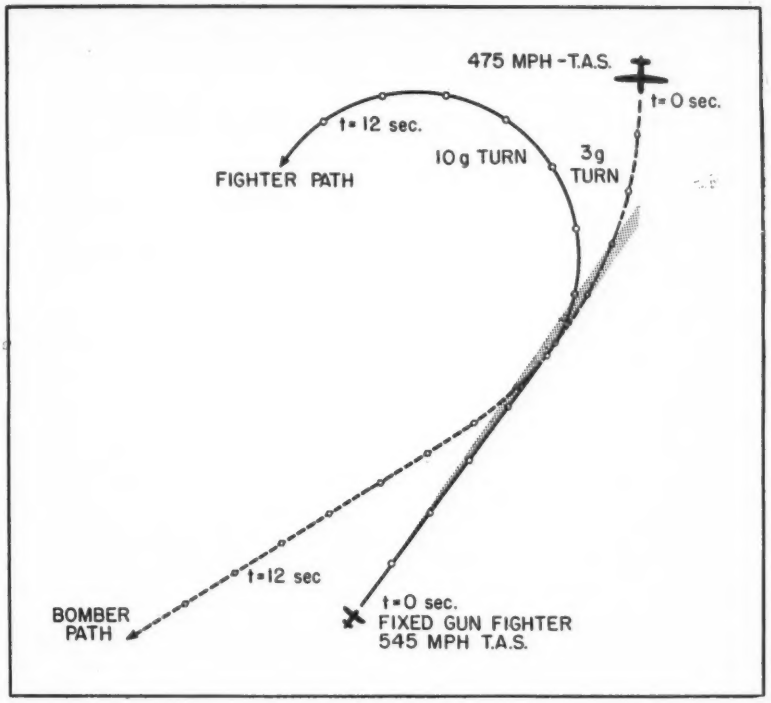

Fig. 3.

Turrets

In light of the definition of defensive armament previously mentioned, it seems necessary to design the bomber's armament system to be capable of defending the airplane against attacks developing from any direction. It is then necessary to determine the type of system fulfilling this requirement which will represent an absolute minimum of drag and weight to be imposed upon the basic airplane. Without specific reference to the profile of the bomber, it would appear that a minimum of drag would be introduced if nose and tail turrets were used, each capable of covering a complete hemisphere. This type of arrangement would achieve fire coverage throughout the complete sphere.

In considering the number and type of guns to be installed in each turret, it is necessary to compromise between two factors: the turret must be small and compact to fit the airplane contours at nose and tail positions; at the same time, the projectiles must have a high muzzle velocity, which implies long gun barrels.

A high muzzle velocity permits two extremely important advantages: first, a high striking power, since the striking power is proportional to the square of the velocity, and second, a short time of flight for any given range which results in a small lead angle to be computed. In addition to these requirements, the guns must have a cyclic rate that permits a high density of fire and increases the number of lethal hits obtained.

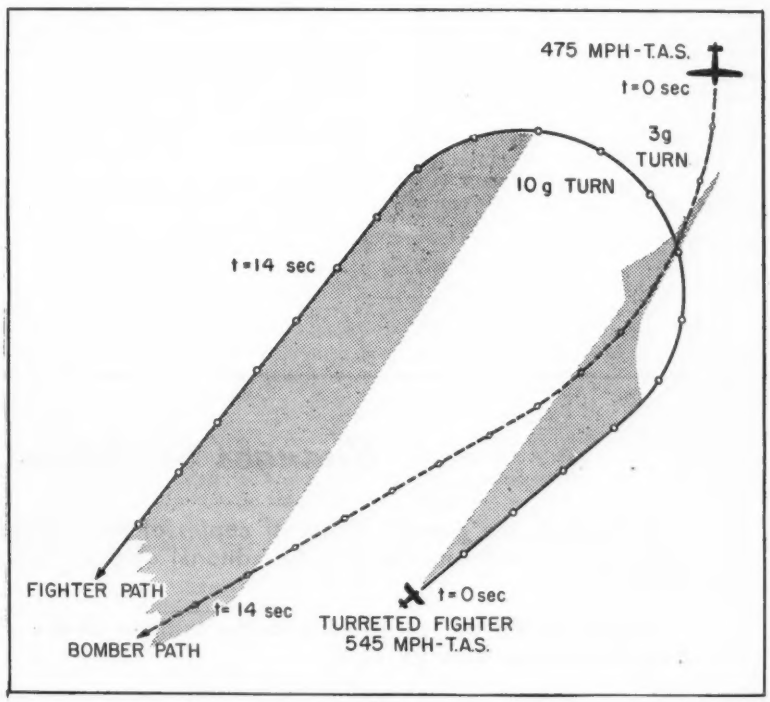

Fig. 4.

The 20-mm. gun would appear eminently worthy of consideration were it not for the size of the gun. The 0.50-cal. machine gun is much smaller but would be more desirable if it had a higher muzzle velocity. Again, considering the importance of low drag, it would appear more desirable to use a multiplicity of 0.50-cal. guns in the turrets and accept the lower muzzle velocity. While this would increase the difficulty of the computation problem, it is certainly not insurmountable.

The actual number of guns to be mounted in either the nose or tail turret cannot be settled without analysis of the space available in the airplane. For an airplane of the size under consideration, it is estimated that four 0.50-cal. guns could be installed in both turrets without compromising the most advantageous contour of the airplane and at the same time permit a minimum length of barrel to extend beyond the skin line. Four guns, firing a total of approximately 50 rounds per sec., permit a reasonably high lethal density in compensation for normal dispersion and system errors in gun laying, which amount to approximately 5 mils. While it would be desirable to run the density of fire as high as possible, it is doubtful that more than four 0.50-cal. guns could be mounted in either nose or tail turret for an airplane of this size without serious compromise to airplane design.

Sights

If the maximum allowable space is used in the nose and tail of the airplane for the turrets, the gunners must be located elsewhere and control the turrets remotely. This represents no difficulty and will probably represent an advantageous arrangement from the standpoint of crew location. Inasmuch as it is assumed that the normal crew will number four, the gunners will undoubtedly perform other duties, thus making it desirable to locate the sighting stations adjacent to other equipment within the pressurized cabin. From the standpoint of the airplane, the sighting station must contribute an absolute minimum of drag, and at the same time permit sighting through an angle equal to, and preferably more than, the angular coverage of the turrets. So-called direct vision sighting stations of the type used on the B-29 are out of the question, since they require blister mounting and cannot cover complete hemispheres. The ideal solution to the problem is found in the periscope, either double-ended, mounted vertically in the airplane, or single-ended, mounted horizontally, and capable of sighting in a forward or aft hemisphere.

The use of a periscope in an airplane armament system is not new. A double-ended periscope having a 70° field of vision and capable of sighting through a complete sphere is currently in use on the A-26 airplane and is giving excellent service. Additional refinements, such as fixed eyepiece and optical range finders, are entirely feasible and have been built into periscopes for other airplanes. Basically, a periscope is suited to the low drag requirements of a jet-propelled airplane because of the fact that the gunner may be located completely within the normal contour of the airplane with only the small periscope head housing optical elements extending beyond the skin line.

The question has often been raised as to the quality of scanning which can be accomplished through a periscope, as compared with that obtained through a Plexiglas blister with the unaided eye. Many tests have been conducted with existing periscopes and it has been determined that equal, or better, scanning can be obtained by means of a periscope having a field of at least 70°.

Computers

The problem of computation for armament systems for high-speed, jet-propelled airplanes is considerably more complex than in any present-day airplanes. Not only does the increased air speed give rise to greater ballistic corrections, but the computation must be accomplished in a shorter time because of the short duration of nose attacks. The implications of attacks from turreted fighters impose new problems in accurate lead computation. Much development work has been directed toward the design of aircraft gunnery computers for applications of this sort and, although the problems are complex, solutions have been found.

The remaining required components of the armament system are reasonably straightforward. Basic principles of remotely controlled turrets have been tried and proved in the B-29, A-26, and P-61 installations. In jet-propelled bombardment airplanes these principles may be used as electrical building blocks to tie the system together. Although these system components do not contribute directly to airplane drag, the weight factor is important and effort must be made to reduce individual component weight consistent with reliability and required performance.

Conclusion

The advent of jet propulsion opens a completely new approach to the design of bombardment airplanes. Operational speeds and altitudes previously considered impractical become not only possible but desirable. In keeping with this progress in basic airplanes and propulsion units, an entirely new set of problems is presented to the armament engineer. Old concepts of defense must be put aside for the new objective of designing armament as a system to fit the individual requirements of the airplane. Such a concept is a departure from the one of completely standardized armament components, but it is necessary if the total airplane, including armament, is to be employed efficiently as a military tool.

Although the armament systems that have been developed for military airplanes represent a vast improvement over those available a few years ago, the ultimate has not yet been reached. Further development in all phases: guns, sights, radar, computers, and accessories, will produce designs far advanced beyond present equipment. This development, however, must be closely coordinated with the design of the airplanes, so that unified and integrated objectives may be attained.

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Structural Design Problems in the B-29 Airplane

GEORGE SNYDER*

Boeing Aircraft Company

ABSTRACT

This paper presents a few of the considerations involved in the development of the structure for the B-29 airplane. The approach to the design of the wing, fuselage, tail surfaces, nacelles, landing gear, and certain miscellaneous details is discussed in terms of the influencing factors and design criteria as related to the airplane structural arrangement and operational requirements.

Although the basic structure of the airplane is not a radical departure from convention, certain problems arose which, with their solutions, may be of interest.

INTRODUCTION

THE B-29 was designed to fulfill the need for a high-speed, long-range, high-altitude bomber with a large bomb-load capacity. The extent to which the design has suited the strategic and tactical efforts of the Pacific campaign is indeed a tribute to the foresight of the Army Air Forces procurement personnel.

The development of the airplane can be directly traced through four preliminary models and can be indirectly related to work done in 1935, making it difficult to establish the exact period properly attributable to the design of the B-29 airplane as we now know it. Therefore, the subject will be approached through discussion of the features of the existing airplane and the engineering philosophy from which they resulted.

Presented at the Los Angeles Meeting, I.A.S., Los Angeles, August 16–17, 1945.

* Chief of Structural Design.

WING—GENERAL

As a result of the long-range and high-speed objectives, it was aerodynamically desirable to utilize a low-drag, high aspect ratio wing of high wing loading. In order that the high wing loading of 70 lbs. per sq.ft. should not compromise the landing and take-off performance, it was further necessary to equip the wing with large, highly efficient flaps. The airfoil section selected for the wing is known as the Boeing 117 section. The main requirements for the airfoil were low drag in the high-speed ranges, exceptionally low drag in the cruising ranges, excellent compressibility provisions, and gradual stall characteristics. The 117 airfoil meets these requirements.

Wing Assembly Breakdown

In the experimental model of the airplane, the wing consisted of two wing tips, two outboard wing panels, and an inner wing panel that was continuous through the fuselage. Subsequently, the wing has been redesigned to have additional manufactured joints on each side directly adjacent to the fuselage-wing juncture. These joints are of a structurally continuous type, and, although a weight penalty was incurred, handling of the assemblies in production has been facilitated.

Wing—Upper Surface

To obtain satisfactory structural efficiency, it was necessary to distribute a large portion of the material resisting beam bending to the interspar surface. As a consequence of the high aspect ratio, this surface material was distributed chordwise in the form of heavy gage skin and large extruded spanwise stiffeners to obtain a suitable balance between torsional rigidity and bending strength. A typical wing cross section is shown in Fig. 1. The degree to which this could be carried was limited by the comparatively large rib spacing, of approximately 35 in., required for efficient design of the fuel storage provisions.

The resulting column length of the upper wing surface required stiffener depths of as great as 2.75 in. and correspondingly heavy gages to obtain the desired high allowable stress of the compression material. After extensive panel testing, combinations of stiffeners and skin were developed which permitted the interspar skin of the upper surface to remain fully effective to a compressive stress of approximately 38,000 lbs. per sq.in. The stiffeners are largely 24ST extruded hat sections, and the skin is 24SRT of thicknesses as great as 0.188 in. These represented the most suitable combinations of materials available during the initial design stages. Subsequent redesign for the use of the high-strength materials now available has resulted in a worthwhile weight reduction. As a comparison of load-carrying requirements, the upper surface of the B-17 airplane carries a maximum load of approximately 3,000 lbs. per chordwise in. against 14,000 lbs. per chordwise in. for the B-29.

Wing—Lower Surface

The lower surface design was influenced greatly by the large cutout at each of the inboard nacelles which permits retracting of the dual wheel landing-gear unit into the wing cavity. Since at this point the lower surface material had to be concentrated primarily in the spar chords and since the camber of the lower surface between spars was comparatively small, the lower surface spar chords were designed to include the largest portion of the bending material consistent with proper strength and rigidity under reverse or negative air loads. Also, large structural doors were required for the installation and removal of the self-sealing fuel cells. Therefore, any reduction of the load in the lower surface interspar material resulted in simplification of the structural connections around these doors.

Outer Wing

Because fuel cells were installed in only the inboard panel of the wing, the rib spacing and constructional details of the outer wing are conventional. Again, however, the balance between spar chord, spanwise stiffener, and wing skin area was influenced by torsional rigidity and surface camber considerations.

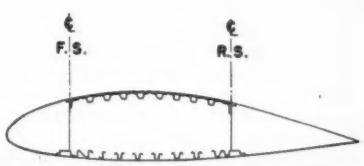

Fig. 1. Typical wing section (no scale).

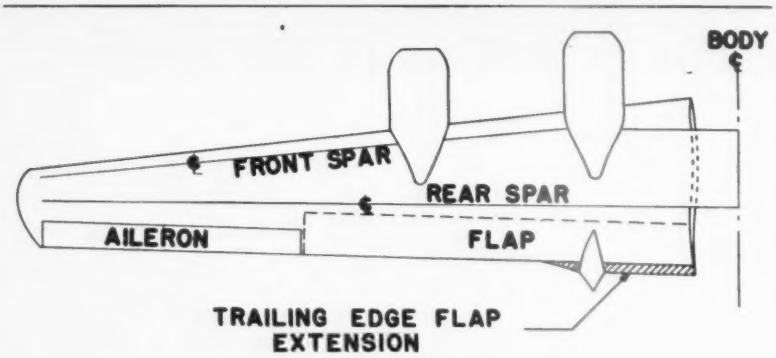

Fig. 2. Diagram—B-29 wing.

Trailing Edge Extension

Fig. 2 shows a plan view of the left half of the B-29 wing. The small, trailing-edge extension between the inboard nacelle and the body juncture has an interesting story behind it which illustrates the type of pitfall existing in current structural design procedures. Wind-tunnel tests of the various model configurations without this extension resulted in lift curves as shown in Fig. 3. Note the reduction of lift which occurred for the complete model less tail as compared with either wing alone, wing plus body or wing plus nacelles. Assuming that the addition of the fuselage to the wing and nacelle combination could not seriously affect the spanwise lift distribution over the outboard wing, the distribution must be severely changed between the inboard nacelles and the body because of aerodynamic interference. With the methods of obtaining the theoretical spanwise air-load distribution currently in use, such a condition could easily be neglected and result in structural failures at less than design load.

The trailing-edge flap extension was added to correct the adverse load distribution and resulted in the lift curve for the wing plus body plus nacelles plus flap extension being essentially the same as for the wing alone. Fig. 4 schematically illustrates the spanwise lift coefficient variation at a constant angle of attack before and after the flap extension was added. This change is estimated to have resulted in a reduction of approximately 30 per cent in the net bending moment at the wing root for a given value of total wing lift.

Landing-Gear Retracting Strut

The arrangement selected for the landing-gear installation in the wing posed an unusual problem. The retraction of the wheels necessitated a cutout in the lower wing surface from the front spar almost to the rear spar. In order that the large landing loads could be reacted with a minimum of additional structure, the main oleo strut was attached to fittings such that the vertical ground loads were carried primarily by the rear spar. The drag strut, in turn, was located to have the load centerline pass through the junction of the upper surface and front spar planes.

However, the retracting mechanism could only be supported in the vicinity of the lower front spar chord because of space requirements. Theoretically, this mechanism carries no load during landings, since it intersects a straight pin jointed member with the gear in the extended position. However, in flight, with the gear retracted,

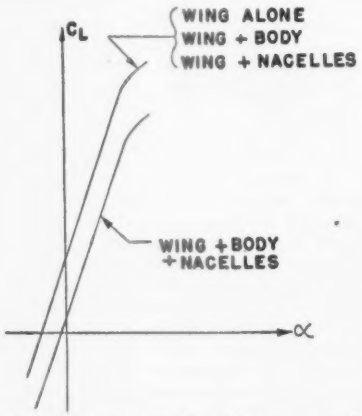

Fig. 3. Effect of model build-up on the lift curve.

the retracting strut acts as a member in the landing-gear support truss and carries a load that must definitely be considered. Obviously, the load component in the plane of the spar can be reacted directly by the spar web. The component normal to the web required the addition of special structure. Consideration was given to routing the load through the nacelle, but this was prohibited by existing interferences.

The solution finally selected as most economical is pictured in Fig. 5 and shown diagrammatically in Fig. 6. A trapezoidal beam was attached to the front spar web, and upper wing surface. An additional pair of trapezoidal shaped beams was attached to the rear spar web, the uncut portion of the lower surface near the rear spar, and the upper surface. The small ends of these beams then reacted to each other through a small transverse beam nearly midway between the spars. The dual beams attached to the rear spar were necessary because of the limited space available with the gear retracted.

Wing to Body Connection

The wing to body connection is another interesting example of a somewhat unusual practice. Initially, the plan was to react the surface and spar web shears of the wing directly into the body structure. However, as the design progressed it became evident that this procedure would result in an inefficient body structure. Hence, it was considered advisable to redistribute some of the surface shears to the spar webs where a more direct connection into heavy body bulkheads could be made. A reasonable percentage of the surface shear was still to be reacted directly by the attachment to the body skin. The solution chosen was the introduction of a shear distributing bulkhead type of rib in the wing. Thus, a redundant structure was created and proper balance between the rib and body skin rigidity was required to ensure that the shears were transferred in the predetermined manner. The resulting rib was designed to carry large loads under conditions of severe buckling.

Wing Detail Design

A direct result of the heavy gages of material required in the primary structure was the introduction of unusual methods of load transfer such as applied to the thrust reaction of the flap track support truss at the upper rear spar chord. Normally, control surface hinges, etc., necessitate special ribs to transfer the loads to the monocoque. However, in the B-29 the skin gages of the upper surface were sufficient to carry the loads in direct edge compression when combined with fittings to spread the loads over a sufficient width. In every possible case the existing structure was used to carry high local loads with the minimum necessary reinforcing or modification.

Development of the Flap Support Structure

For aerodynamic efficiency a completely enclosed, circular arc, track and

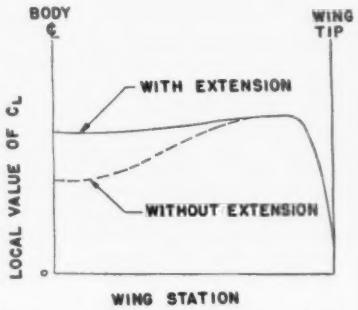

Fig. 4. Effect of trailing edge flap extension on spanwise variation of C_L.

carriage system was selected for the flap guiding and supporting structure. Because of limited space available and the extremely high loads from the abnormally large flaps, standard bearings and cam followers were found to be unsatisfactory. The development program, which finally produced a satisfactory combination, was quite educational.

Ball-type bearings were immediately eliminated from consideration because of load and space limitations. A few roller bearings were tested but were soon ruled out, for similar reasons, in favor of the needle type. However, existing standard needle bearings were found to be unsatisfactory in one or more of the following respects.

(a) The tolerances on the needles and races were too large. As a result the axes of the outer race and inner race could become misaligned sufficiently so that the needles would "spiral."

Similarly, the bearings rolled with point contact on the corners instead of line contact on the faces.

(b) Sharp corners on the face of the outer race produced severe track brinelling.

(c) The bond of the chromium plating to the face was not sufficiently strong to prevent flaking of the plating under continuous operations at high loads.

(d) The outer race thickness was not great enough to prevent fatigue failures of this race in bending.

(e) Tires could not be used, since they could not be mounted securely enough to ensure long life without loss of the tires.

As a result of these tests a series of new bearings were developed to suit the severe design conditions and eliminate the undesirable features of the standard bearings then in existence.

The design of the curved track also posed several problems. The surface hardness, protective finish, machining procedures, elastic rigidity, material, and heat-treatment were selected on the basis of the test program. Of particular note is the importance of maintaining consistent deflection of the cantilever track flange and bearings mounted in the carriage. Unless the bearing axis and the track flange surface are parallel under all variations of load, the needle bearings will bind and fail prematurely.

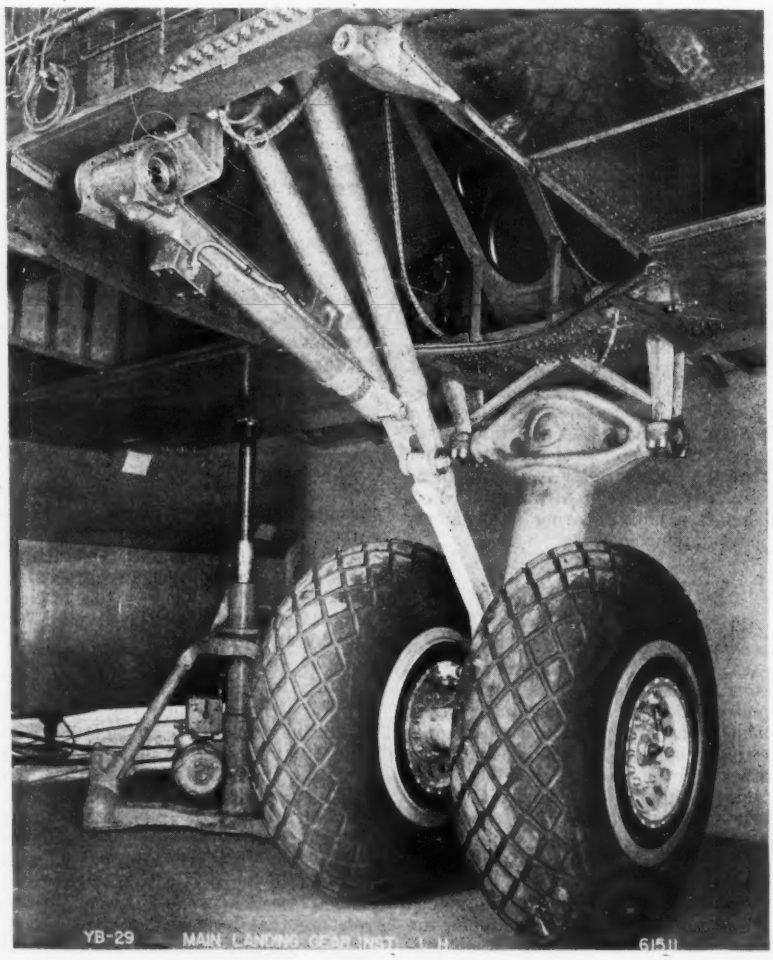

Fig. 5. Wheel well and landing-gear installation details.

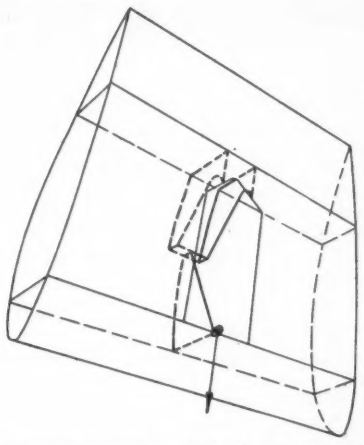

Fig. 6. Bottom view of wheel well and landing-gear screw support structure.

Landing Gear

The landing-gear arrangement is of the conventional nose-wheel type with dual wheels on all units. Retraction is accomplished electrically by acme thread screw and nut combinations attached to elbows in the drag bracing trusses. The service record of the B-17, which has a similar gear geometry, influenced the decision as to general arrangement.

The ground loading criteria for nose-gear type airplanes was undetermined during the initial design stages. Thus, it became necessary to develop the design conditions in cooperation with the Structures Laboratory at Wright Field. Many of those selected are similar to those shown in *ANC-2*. A few of the special considerations applied were:

(a) A condition of ground turning in which the airplane rotated about the center of the tire contact area of one braked main gear unit. For multiple-wheel installations equipped with brakes this ground-handling condition may design the torsion structure of the gear.

(b) The nose-gear shock-strut orifice and pin were selected on the basis of drop tests at a weight considerably in excess of the static nose-gear reaction. This procedure was adopted to ensure satisfactory action of the nose-gear unit under conditions such as nose-first landings, soft surface runways, etc., in which the nose-gear load is not purely a function of static load distribution. The resulting increase in nose-gear energy absorption capacity has since been justified by analysis of the service reports.

(c) A tail skid incorporating a shock strut was provided to protect the body structure in tail-down landings. The skid was designed to withstand a tail-first landing at an ultimate vertical velocity of 500 ft. per min.

One of the detail problems in the design of the main landing-gear struts was the determination of a suitable method of attaching the oleo cylinder head to the cylinder. The ultimate pressure of 5,300 lbs. per sq.in. resulted in the decision to shrink-fit the two parts to-

gether by assembling them while at a large temperature differential. Satisfactory results were obtained by this method. However, soon thereafter the manufacture of the landing-gear units was subcontracted to a firm specializing in high strength, electric, shielded arc welding. Reconsideration of the complete design under these circumstances has resulted in the use of welding wherever possible to expedite manufacture. A definite weight-saving was accomplished through this redesign.

Towing Loads

Towing loads applied to the nose gear have exceeded three-tenths of the airplane weight. These loads are undoubtedly dynamic arising from the use of small towing equipment with the accompanying tendency to use the play in the towing linkage to get a running start instead of using a steady draw.

Nacelles

The basic nacelle structure is conventional semimonocoque incorporating a welded steel tube engine mount. However, because of the high wing loading and aspect ratio and the size of the power plant, the outboard nacelle is large and deep in comparison with the local wing cross section. The centroid of the nacelle and power-plant mass is located near the shear center of the "C" section formed by the two surfaces and the front spar, resulting in a negligible load transfer at the rear spar. Also, since the weight is ahead of the elastic axis, no flutter problem arises. The critical design condition, an unsymmetrical gust, produced load factors at the outboard nacelles approximately one-third higher than the symmetrical loading conditions. During the drop testing of the airplane, even slightly higher dynamic load factors were recorded, but the margins of safety provided in the structure were ample to prevent failure.

In the detail design of the nacelle equipment installations, a definite effort was made to ensure against fatigue failures of miscellaneous brackets. The criteria applied consisted of an arbitrary load of 20 times the dead weight of the article supported, acting in any direction. Records to date indicate that sufficiently trouble-free service has resulted to justify whatever small weight increases may have been involved.

Design of Empennage and Control Surfaces

Except for the inclusion of a Steady Dive Plus or Minus Gust supplemental design condition, the tail surface design proceeded along traditional lines. This Steady Dive condition is obtained by considering the airplane to be in a trimmed glide at a constant high speed, with the effects of a gust in either direction superposed when more critical. Airplanes incorporating wings with low moment coefficient type airfoils may have comparatively small net balancing tail loads under such conditions. But if the tail is in the area affected by wing down-wash, the stabilizer may have a negative angle of attack, depending on the stabilizer setting. Thus, to obtain a small net or balancing load on the tail, the elevator must be trimmed with a corrective deflection. The resulting condition often produces high torsional moments. Surface twist under these loads may aggravate the situation considerably unless sufficient torsional rigidity is provided.

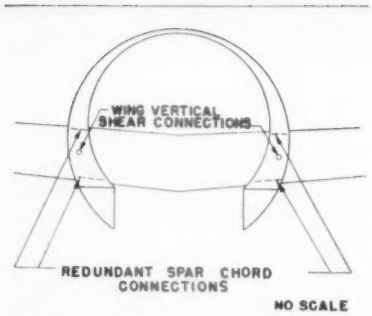

Fig. 7. Typical wing connection frame in fuselage.

Fuselage Pressure Bulkheads

The bomb-fall clearance requirements in the bomb bays made the length of the airplane dependent to a certain extent upon the space devoted to the pressure bulkheads. The choice of bulkhead contours was limited to a conical, spherical, or ellipsoidal segment for practical reasons. However, the ellipsoidal segment was finally selected because the conical section of equal weight would have required considerable extension of the body and because the portion of a sphere of sufficiently large radius to suit space limitations would require an extremely heavy bulkhead ring to prevent collapse of the body at the bulkhead juncture when under pressure. The final refinement resulted in selection of the portion of an ellipse of revolution such that the hoop stresses in the bulkhead skin were nearly zero at the outer edges. Thus, the bulkhead ring resisted only the meridional loads.

Fuselage Catwalk

For aerodynamic reasons the fuselage is a long, slender section with low frontal area. The desired bomb capacity necessitated two bomb bays, one forward and one aft of the wing intersection. Thus, the lower portion of the monocoque is cut out for bomb doors along much of the fuselage length. Satisfactory support for bomb racks, body bending strength, and other factors dictated that the bomb bays be framed with heavy longitudinal structure. Beams of approximately triangular cross section resulted and are continuous through both bomb bays and under the wing. Because the fuselage is not perfectly cylindrical in the aft bomb bay, these catwalks are bent continuous beam columns subject to torsional moments. The complexity of analysis should be readily apparent.

Intercommunication Tunnel

The separation of the two main pressurized compartments by the bomb bays required that a means of access from one compartment to the other be provided. Therefore, an intercommunication tunnel along the top of the bomb bay area was provided. It was desired that this tunnel be subjected to pressure loads only. To ensure that fuselage bending moments were not resisted by the tunnel structure, accordian-type "pleats" were incorporated in the tunnel, reducing the rigidity to satisfy the desired load distribution.

Turret Wells

The installation of turrets in the pressurized sections produced the problem of designing a satisfactory turret well to act as a pressure seal in addition to satisfying the normal cutout framing difficulties. Again, a contour of approximately elliptical generation was selected for the domes because of space limitations. The skirts are of cylindrical design incorporating sufficient reinforcement to prevent instability buckling when subjected to pressure. An attempt was made to avoid the use of any skin patches around turret and window cutouts because of production complications, such as joggles, resulting therefrom. Design problems were numerous, but the gains were considered well worth the effort expended.

Fuselage Frames at the Wing Spars

In Fig. 7 it will be noted that the fuselage frames at the wing to body juncture are comparatively light. This reduction of size was accomplished in a rather unique manner. The wing to body vertical shear connection was accomplished in the conventional manner, but, in addition, the fuselage frames were provided with a shear tie to the upper and lower wing spar chords. Thus, any moment arising from eccentricity between the vertical shear load and reaction points on the frames is resisted by couple loads in the spar chords. The redundancy of such an arrangement was handled by keeping the fuselage frames of a properly reduced rigidity at the top centerline of the body.

Conclusions

In the paragraphs above, several of the structural characteristics of the B-29 airplane have been discussed with a view toward presenting the basic conceptions involved. No attempt has been made to dwell upon technical details, since these are only of interest as applied to the particular design. The examples cited should serve to emphasize that airplane design is a continual compromising of opposing factors toward the goal of the most efficient arrangement for a given set of conditions.

Runway Orientation in Terms of Aircraft Take-Off and Landing Characteristics

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Army Air Forces

ABSTRACT

A method is presented for evaluating, in terms of aircraft performance characteristics, the type of wind information used in laying out airfields. This method, developed for military use, is equally applicable to the analysis and design of civil airfields. The maximum beam wind considered safe for landing or take-off of a given type of airplane is used together with wind data recorded at the airfield site to compute the directions of runways required for safe operation throughout the year.

A new type of wind rose is introduced, together with transparent celluloid fans that facilitate the computations.

RUNWAY REQUIREMENTS

AT THE OUTBREAK OF THE WAR, aircraft, both civil and military, were relatively light in weight and were equipped, with a few exceptions, with the conventional type of landing gear. Such aircraft were sensitive to crosswinds on landing and take-off, and it was necessary to provide sufficient runways, variously oriented, to permit them to land and take off close to the wind, no matter which way the wind blew. Aircraft in use today are in general heavier and have higher landing speeds, and most planes of the newer types are equipped with nose wheels that make them less sensitive to crosswinds than the older types. As a result of these developments, a smaller number of runways is now required, particularly for large aircraft, and accepted theories of airfield design can be modified accordingly, with resultant economies in construction and greater efficiency in planning. Where formerly it was a basic hypothesis in planning military airfields that runways might be required in four directions, cases can now be cited where one or more runways oriented in a single direction meet the requirements of military aircraft. Runways in two directions are often sufficient. Runways in additional directions are now provided only where local prevailing winds and terrain conditions are such that runways in one direction will not permit safe operation 90 per cent of the time.

A prime necessity for determining the percentage of time any given runway may be used is accurate local wind data. Until recently, the principal sources of such data were the "Normal Wind Roses," prepared by the Airport Section of the Civil Aeronautics Administration, U.S. Department of Commerce, Washington, D.C.; the "Low Visibility Windrose Summary (Technical Development Note No. 22, July, 1940)," published by the same agency; "The Airway Meteorological Atlas of the United States" and "Normal Surface Wind Data for the United States," the latter two published by the Weather Bureau, U.S. Department of Commerce, Washington, D.C. To these data can now be added summaries of wind data recorded by units of the Weather Division, Army Air Forces, stationed at many Army Air Forces' airfields. These data are at present available for military use, and arrangements are being made whereby they will soon be turned over to the Weather Bureau. The combined coverage of all these data is, in general, sufficient to meet the needs of airport planners in all parts of the country.

A further necessity for accurate work of this nature, and one that has not heretofore been provided, is a satisfactory method of evaluating the wind data applicable to a given airfield site in terms of the performance characteristics of aircraft to be accommodated. The method of evaluation described in this paper has been developed by the author while on duty in the Air Installations Division, Office of Assistant Chief of Air Staff, Matériel and Services, Headquarters, Army Air Forces, Washington, D.C., and has been used with success in determining the proper orientation for runways on new airfields and the relative usefulness of individual runways on existing airfields. The accuracy of the method, its simplicity, and its adaptability to use in solving

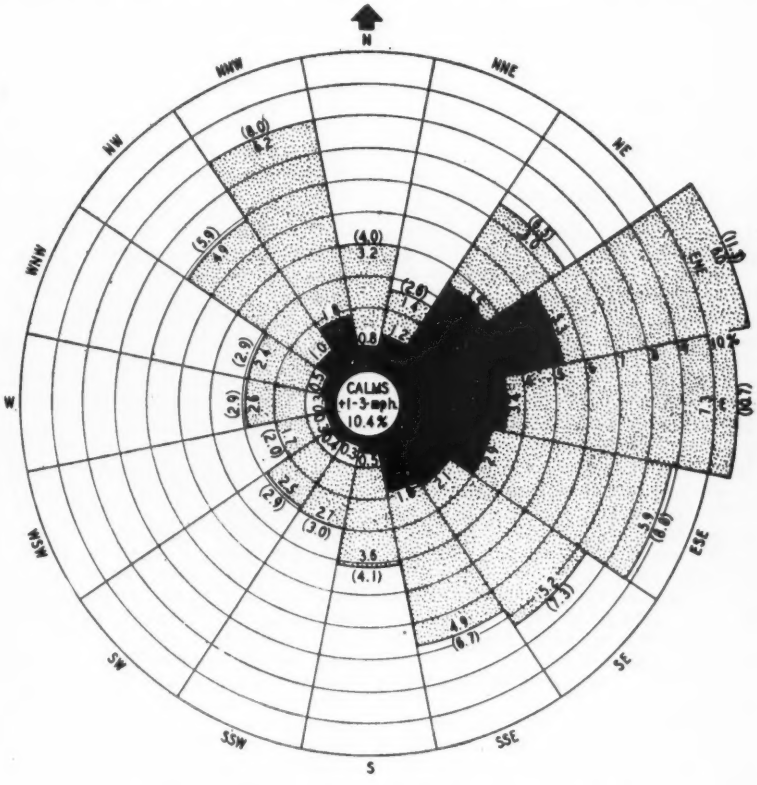

Fig. 1. Typical surface wind rose.

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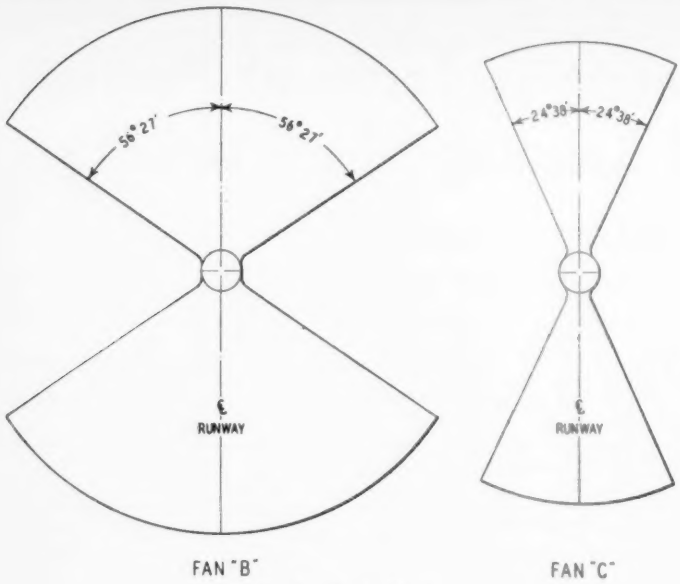


Fig. 2. Typical fans.

many problems involving the direction of runways warrant its general acceptance and use by airport planners.

Briefly stated, the method involves (a) the preparation of a wind rose portraying graphically the sectors of a circle in which surface winds of critical velocities prevail at a given site; (b) the preparation of transparent fans indicating the permissible angles between the path of landing or take-off and the winds of critical velocities; and (c) the use of both the wind rose and fans to determine, insofar as wind conditions are concerned, the percentage of time during which a specified type of airplane can safely land or take off in a specified direction.

The Wind Rose

Wind roses used heretofore have indicated the percentages of surface winds recorded in the principal compass directions by lines radiating from a central point. Where a distinction was made between winds in different velocity groups, lines of different thicknesses were employed. Such a wind rose does not permit rapid reading of the effect of components of winds in adjacent directions, and a different type of rose has been developed which facilitates this process (see Fig. 1). In the preparation of this type of rose, wind data are separated into the following velocity groups (which are combinations of divisions on the Beaufort wind scale):

(a) Calms and winds of velocities up to and including 3 m.p.h.

(b) Winds of velocities from 4 to 12 m.p.h.

(c) Winds of velocities of 13 m.p.h. and over.

The total of the percentage of calms and percentage of winds of velocities up to and including 3 m.p.h. in all directions is indicated numerically in the center circle of the wind rose. The percentages of wind in velocity groups (b) and (c) are indicated by sectors covering both sides of each compass direction from which winds blow, radiating from the center circle and extending outward distances proportional to the percentages of time the winds were recorded. For convenience in reading, the percentages of group (c) are placed next to the center circle and are shown solid color. The percentages of group (b) are placed outside those of group (c) and are shown as shaded areas. Numerals indicating the percentage in each group are placed on the arc of each sector, and numerals indicating the total of groups (b) and (c) in each direction are indicated in parentheses outside the shaded areas.

It will usually be sufficient to prepare only one wind rose for a given site, a rose showing the annual percentages of surface winds during all conditions of visibility based upon hourly observations, 24 hours a day, for the period of record. Occasionally, it may be desirable to prepare an additional rose covering periods of low visibility only. Such a rose is useful in determining the runway direction required for use during instrument flight operating conditions. It is highly desirable to obtain monthly summaries of wind data covering the period of record and to review them carefully in order to determine whether the annual summary gives a true picture of average conditions for each month. In some localities winds prevail in certain directions only during certain seasons and for a limited period of time, and their influence upon the annual wind rose is not easily detected. Whenever these seasonal winds are strong, they should be considered in determining the number and directions of runways needed to permit uninterrupted operations throughout the year.

Long periods of record offer the most reliable data for preparation of wind roses, and it is desirable to employ data covering at least 5 years. When the period of record at the actual airfield site is shorter than 5 years, the data should be compared with longer records made at other locations in the vicinity and allowances made for conditions peculiar to the period covered by the records made at the airfield site.

Fans

From data obtained in flight tests, an operational value can be determined for the maximum beam wind (the wind at 90° to the direction of the runway) which can safely be encountered in landing or take-off by a given type of airplane under average conditions. In order that the component normal to the runway of any anticipated wind may not exceed the maximum allowable beam wind, the angle between the runway direction and the wind direction must lie within the limits imposed by the following relationship: $\sin \alpha \leqq v/V$, where

α = the angle between the runway direction and the wind direction

v = the maximum allowable beam wind value for the airplane

V = the velocity of the given wind

Applying the above relationship, it is found that a runway oriented within 56° 27′ of the direction of a wind of 12 m.p.h. velocity can safely accommodate an airplane capable of landing or taking off with a maximum allowable beam wind of 10 m.p.h. Similarly, a runway oriented within 24° 38′ of the direction of a wind of 24 m.p.h. velocity will be satisfactory for the same airplane.

The two angles thus obtained—one for 12-m.p.h. winds and one for 24-m.p.h. winds—are used in preparing the fans that show the percentage of time this particular type of airplane can land or take off safely on a runway oriented in any specified direction. These fans are cut out of transparent material, in shapes similar to those shown in Fig. 2, with the axis diameters approximately equal in length to the diameter of the wind rose employed. As will be noted, the sides of fan "B," used in determining the coverage of winds in group (b), form angles of 56° 27′ with the axis. The sides of fan "C," used in computing the coverage of winds in group (c), form angles of 24° 38′ with the axis.

Although 24 m.p.h. is not the highest wind velocity encountered in the United States, this value is high enough to include all except a relatively small percentage of high winds that may be encountered. Should local wind data indicate a higher percentage, say 3 per cent or more, of winds above this figure distributed among several compass directions, a third fan should be made. Since

10 m.p.h.* is the maximum beam wind velocity currently considered safe for present-day tactical aircraft, this value is used in computing coverages for military airfields—except training fields.

Values used for safe maximum beam wind velocities applicable to other types of aircraft should be determined before applying this method to the planning of civil or commercial airfields.

Method of Evaluating Wind Data

By superimposing fans "B" and "C" successively on the wind rose and orienting them in various directions, the percentages of winds in velocity groups (b) and (c) which can be safely encountered on landing or take-off may be read directly from the wind rose. The total of the percentages of the sectors covered by the fans is found, and to these is added an allowance for those winds in group (b) of velocities between 4 and 10 m.p.h. which lie outside the areas covered by fan "B." It has been found from a study of wind data for a great many different locations in the United States that 90 per cent of the winds in this group are generally 10 m.p.h. or less.

The total of group (b) covered by fan "B" is accordingly increased by a figure corresponding to 90 per cent of the rest of the winds in the group. (This assumption would not necessarily be true in the case of a different permissible beam wind. Similar studies would be required to determine appropriate factors to be used in such cases.)

The total percentage of time during the year when aircraft of the type considered can safely land and take off in the specified direction equals the sum of the percentages of calms and winds in group (a) without regard to direction, *plus* the sum of the winds in group (b) covered by fan "B" (to which is added 90 per cent of the balance of winds in group (b) not covered by fan "B"), *plus* the sum of the winds in group (c) covered by fan "C."

The process can be simplified if the value of the safe maximum beam wind is used as the upper limit of a velocity group. When this value is used as the upper limit of group (b), only one fan is usually needed.

It is frequently impracticable to use this value for the upper limit of a group, because wind data are seldom recorded in convenient velocity groups and the laborious computations involved in breaking the data down are not justified.

* The velocity 10 m.p.h. was adopted by Headquarters, Army Air Forces, in order to ensure safe operation of all types of tactical aircraft in current use. Many types are known to land and take off in beam winds of much higher velocities, and it is anticipated that this figure will be raised when justified by performance records.

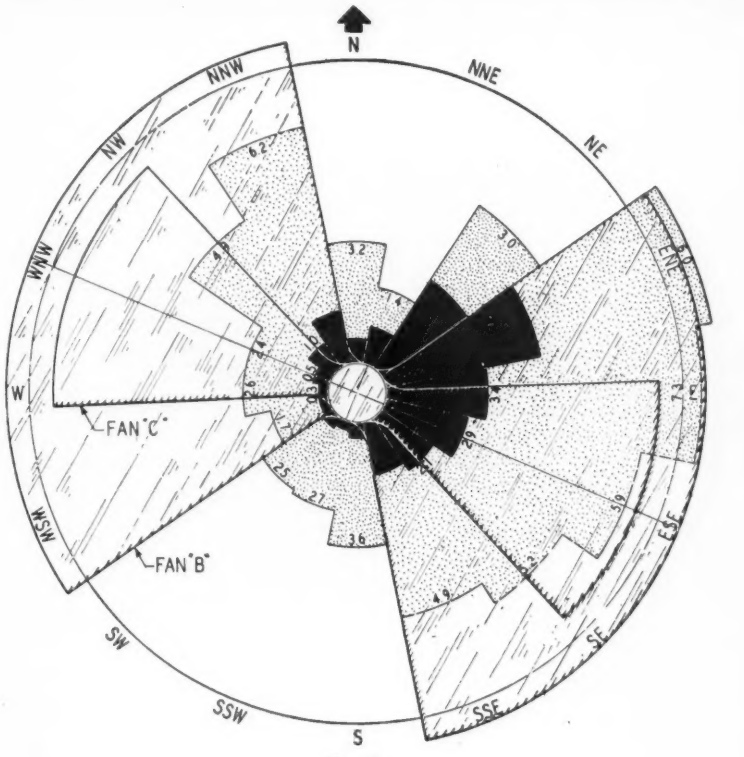


Fig. 3.

Applications of the Method to Practical Problems in Airfield Design

Laying Out a New Airfield

Probably the most important problems to which this method may be applied are those involved in laying out the runways for a new airfield. The method discussed in this paper is readily adaptable to the solution of such problems.

In effect, *the airfield is laid out on the wind rose,* and not until after the number of runways and their directions have been tentatively decided is the study transferred to a topographic map.

In the following example, fans "B" and "C" are used in planning an airport for military aircraft on a site having Fig. 1 for its normal surface wind rose. (Fig. 3 shows the wind rose with both fans superimposed upon it.)

Fan "B" is first superimposed on the wind rose, pinning its center over the center of the wind rose so that it can be rotated freely. The fan is then rotated and the coverage of winds, particularly winds in group (b), is observed. It is usually possible to determine by inspection the position of the fan that covers the largest percentage of winds. In the case under consideration, this position will be found to be where the major axis of the fan is oriented WNW/-ESE. In this position the coverage of winds in group (b) is found by adding the percentages of the sectors covered by the fan. Thus:

ENE	=	6.0%
E	=	7.3
ESE	=	5.9
SE	=	5.2
SSE	=	4.9
WSW	=	1.7
W	=	2.6
WNW	=	2.4
NW	=	4.9
NNW	=	6.2
Total winds in group (b) covered by fan "B"	=	47.1%

Before removing the fan, the winds of group (b) *which are not covered* by fan "B" are noted, and the sum of their percentages is obtained. As noted in the general discussion of this method, 90 per cent of the winds in this category are included to account for those having velocities of from 4 to 10 m.p.h.

N	=	3.2%
NNE	=	1.4
NE	=	3.0
S	=	3.6
SSW	=	2.7
SW	=	2.5
Total winds in group (b) not covered by fan "B"	=	16.4%
90% × 16.4	=	14.76%, or 14.8%

Fan "B" is replaced with fan "C," oriented identically, and the sum of the winds in group (c) covered is:

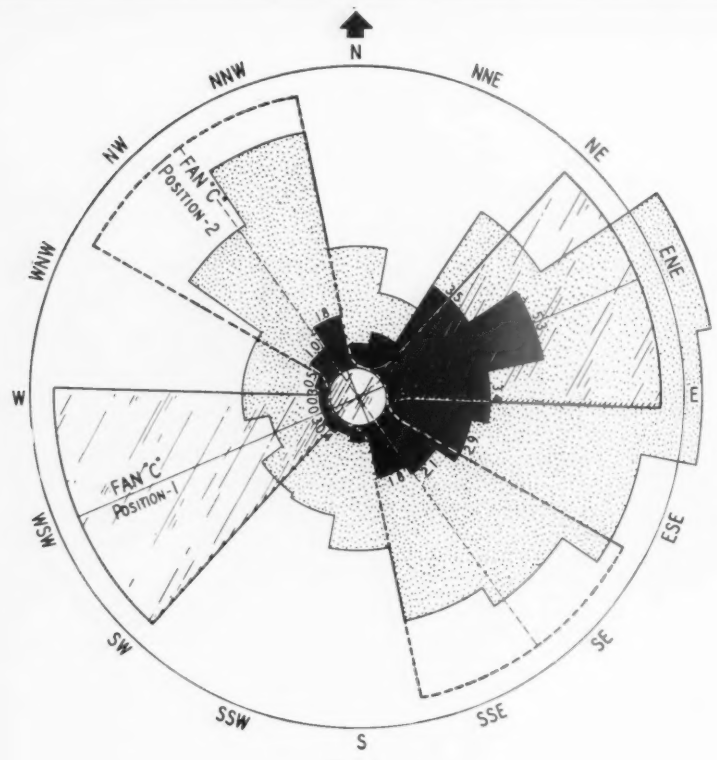


Fig. 4.

E	= 0.6 × 3.4%	= 2.04%
ESE	=	= 2.9
SE	= 0.6 × 2.1%	= 1.26
W	= 0.6 × 0.3%	= 0.18
WNW	=	0.5
NW	= 0.6 × 1.0%	= 0.60
Total winds in group (c) covered by fan "C"		= 7.48%, or 7.5%

The total coverage of a runway in the direction selected is found by adding the coverages of the various groups. Thus:

Calms and winds in group (a)	= 10.4% (from Fig. 1)
Winds in group (b) covered by fan "B"	= 47.1
90 per cent of the balance of group (b)	= 14.8
Winds in group (c) covered by fan "C"	= 7.5
Total coverage of runway	= 79.8%

It seems reasonable to assume that the direction selected—namely, WNW/ESE—provides the best possible coverage, since fan "B" obviously covers the greatest possible percentage of winds in group (b) when aligned in this direction.

However, this may not be the case, and it is necessary to consider the direction that offers the greatest possible coverage of *strong winds* before assuming that the optimum direction has been found.

In this case, such a direction is found to be WSW/ENE. (See Fig. 4, which shows fan "C" oriented in the two positions discussed below.) The coverage of this direction (Position 1) is found as follows:

Calms and winds in group (a) equals 10.4 per cent.

Winds in group (b) covered by fan "B":

NNE	= 1.4%
NE	= 3.0
ENE	= 6.0
E	= 7.3
ESE	= 5.9
SSW	= 2.7
SW	= 2.5
WSW	= 1.7
W	= 2.6
WNW	= 2.4
Total	= 35.5%

Winds in group (b) not covered by fan "B":

N	= 3.2%
SE	= 5.2
SSE	= 4.9
S	= 3.6
NW	= 4.9
NNW	= 6.2
Total	= 28.0%

90% × 28% = 25.2%

Winds in group (c) covered by fan "C" (illustrated by Fig. 4):

NE	= 0.6 × 3.5%	= 2.10%
ENE	=	5.3
E	= 0.6 × 3.4%	= 2.04
SW	= 0.6 × 0.4%	= 0.24
WSW	=	0.3
W	= 0.6 × 0.3%	= 0.18
Total		= 10.16%, or 10.2%

Total coverage for direction WSW/-ENE (Position 1) equals 81.3 per cent.

The greater coverage provided by this direction suggests that the winds in group (b) are of secondary importance in selecting the optimum runway direction and that attention should be directed first to the winds in group (c). This will be found to be true of all cases where the allowable beam wind is 10 m.p.h. or greater. In such cases, one runway, no matter which way it is oriented, will cover at least 90 per cent of the winds in group (b).

Assuming that the coverage of Position 1 is not considered sufficient for the operations contemplated, the next step is the determination of the best direction for a second runway. In general, it will be found advisable to orient the second runway in a direction approximately 90° from that of the first one. Accordingly, fan "C" is rotated to Position 2, which provides the best coverage of winds in group (c) in this general direction. The additional coverage provided by the second runway is found:

ESE	= 0.2 × 2.9%	= 0.58%
SE	=	2.1
SSE	=	1.8
WNW	= 0.2 × 0.5%	= 0.10
NW	=	1.0
NNW	=	1.8
Total winds in group (c) covered by fan "C"		= 7.38%, or 7.4%

To this must be added the balance of winds in group (b) not covered by the first runway:

10% × 28% = 2.8%

Total additional coverage provided by a second runway in Position 2 equals

7.4% + 2.8% = 10.2%

Total coverage provided by two runways in Positions 1 and 2 (Fig. 4) equals

81.3% + 10.2% = 91.5%

On Figs. 5 and 6 are plotted alternate directions for two runways on this site (Positions 1a and 2a) which appear to offer a greater coverage of winds in group (c) and might therefore be expected to provide a greater total coverage than Positions 1 and 2 offer. Their coverage is computed as follows:

Calms and winds in group (a)	= 10.4%
Total winds in group (b)	= 63.5%

Winds in group (b) not covered by fan "B" in either Position 1a or Position 2a (see Fig. 6):

N	= 0.6 × 3.2%	= 1.92%
SSE	= 0.2 × 4.9%	= 0.98
S	= 0.6 × 3.6%	= 2.16
NNW	= 0.2 × 6.2%	= 1.24
	Total	= 6.30%

Winds in group (b) not accounted for by runways in Positions 1a and 2a equals

$$10\% \times 6.30\% = 0.63\%$$

Winds in group (c) covered by fan "C" in Positions 1a and 2a (see Fig. 5):

NE	=	3.5%
ENE	=	5.3
E	=	3.4
ESE	=	2.9
SE	= 0.4 × 2.1% =	0.84
SW	=	0.4
WSW	=	0.3
W	=	0.3
WNW	=	0.5
NW	= 0.4 × 1.0% =	0.40
	Total =	17.84%, or 17.8%

Total coverage of the two runways in Positions 1a and 2a equals

$$10.4\% + (63.5\% - 0.63\%) + 17.8\% = 91.1\%$$

In determining whether to adopt the directions indicated by Positions 1a and 2a instead of Positions 1 and 2, consideration should be given to the monthly wind summaries. In exceptional cases where terrain irregularities cause the prevailing winds to be channeled in a few well-defined directions, it may be desirable to adopt runway directions such as Positions 1a and 2a. However, such cases are rarely encountered in the United States, and it will generally be found advisable to adopt divergent runway directions such as Positions 1 and 2.

Determination of the Relative Usefulness of Several Runways on an Existing Airfield

The necessity for determining the relative importance, from the standpoint of wind coverage, of several runways aligned in different directions arises when an existing airfield is enlarged or reconstructed to accommodate additional traffic or to permit its use by heavier aircraft. The selection of the original runway directions may have been based upon limited wind data available at the time the field was constructed. More accurate data may now be available, and, if so, it should be used in determining the relative usefulness of the existing runways. Such studies indicate which runways, if extended, will be aligned with the wind most of the time and are therefore most likely to be used. These studies, together with calculations of estimated traffic and studies of the terrain and soil conditions, provide the information needed to determine which of the present runways should be expanded and, in some cases, indicate the desirability of abandoning one or more existing runways in favor of new ones differently oriented.

In determining the relative usefulness of existing runways, the direction of each runway should be plotted on the wind rose and the coverage computed for each direction and for each combination of directions. These coverages are computed in exactly the same manner as the coverages of directions proposed for runways on a new airfield. As in the case of a new airfield, consideration should be given to the monthly wind summaries in order to ensure that runways are provided in directions that will permit safe operation at all times in the year.

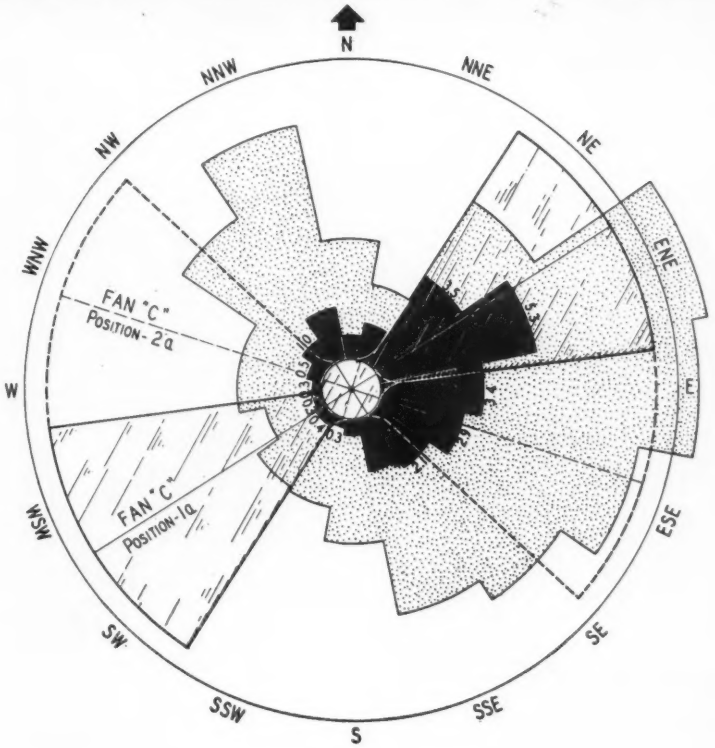


Fig. 5.

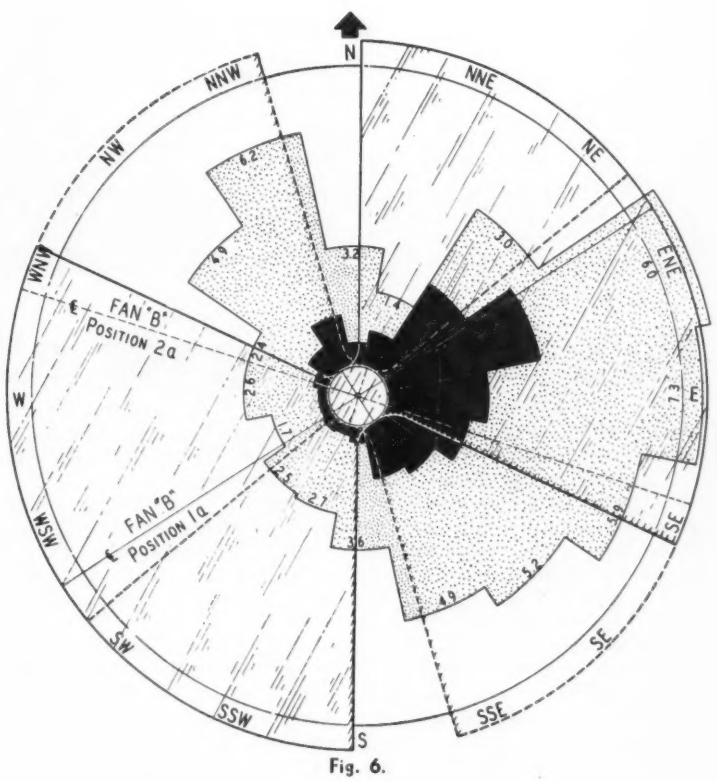


Fig. 6.

He's shaking hands with 90° below

RUBBER PARTS for planes have to function properly at the lowest temperatures apt to be encountered in flight. So B. F. Goodrich moved those temperatures into the testing laboratories.

They built a large new "cold room" —a refrigerator 30 feet long and 15 feet wide. In three of five chambers, a temperature of 64° below zero can be maintained. And then there's the extra-cold chamber where a smaller box manufactures a 90° below temperature.

The man in the picture above is testing airplane hose in the extra-cold chamber. The hose has to be able to flex in stratosphere cold. B. F. Goodrich technicians know that if it can stand *this* test and stay flexible, there is little to fear from nature.

The war proved how necessary this kind of testing is. Ground temperatures of 65° below were encountered in Alaska and Siberia. And at high altitudes, even lower temperatures were recorded.

That's why so many B. F. Goodrich products for planes now get the sub-zero treatment. Hydraulic hose, carburetor diaphragms, accumulators, de-icing equipment, air valves, fuel cells and others have to prove they function properly at low temperatures before they get on an airplane.

This new B. F. Goodrich cold room is an important aid to new product development and research. It is one more example of the way B. F. Goodrich keeps ready to meet the demands of *tomorrow's* aviation customers. *The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

Institute News

Institute Honors and Awards

T. P. Wright Receives Daniel Guggenheim Medal for 1945 and Becomes Honorary Fellow of the Institute

Theodore P. Wright, Past-President of the Institute and Administrator of the Civil Aeronautics Administration, has received the Daniel Guggenheim Medal for 1945, "for outstanding contributions to the development of civil and military aircraft and for notable achievement in assuring the success of our wartime aircraft production program." In addition, Mr. Wright was the recipient of an Honorary Fellowship in the Institute in further recognition of his achievements. The presentations were made by Dr. J. C. Hunsaker, Chairman of the National Advisory Committee for Aeronautics.

The Daniel Guggenheim Medal was created for the purpose of honoring persons who make notable achievements in the advancement of aeronautics. Provision for the Medal was made in 1928 by a gift from the Daniel Guggenheim Fund for the Promotion of Aeronautics.

Honorary Fellows of the Institute are elected by the Honorary Fellows and Fellows of the Institute residing in the United States. It is one of the highest honors the Institute confers upon persons of pre-eminence in aeronautics. Not more than one Honorary Fellow residing in the United States or more than one Honorary Fellow residing in a foreign country may be elected in any one year.

T. P. Wright.

Mr. Wright was born in Galesburg, Ill., on May 25, 1895. His formal education includes the degree of B.S. from Lombard (later Knox) College in 1915, and the degree of B.S. in Architectural Engineering from the Massachusetts Institute of Technology in 1918. In 1937, he received an Honorary Doctor of Science degree from Knox College.

While at M.I.T., Mr. Wright enrolled in the U.S. Naval Reserve Flying Corps, was commissioned an Ensign in 1918, and was promoted to Lieutenant (j.g.) in 1919 and Lieutenant in 1920. He was later appointed as an inspector of naval aircraft and, during his last year of service in 1921, was appointed Superintendent of Construction of Naval Aircraft for the New York district.

He became Executive Engineer at the Curtiss Aeroplane and Motor Company in 1921, progressively advancing to the positions of Assistant Factory Manager, Assistant Chief Engineer, and, in 1925, Chief Engineer of the company's Airplane Division. In this capacity he was largely responsible for the development of prize-winning Pulitzer and Schneider Cup racers and was in charge of the development of the "Tanager" plane, winner of the Guggenheim Foundation Prize for Safe Aircraft Competition of 1930. In 1937, he became Vice-President and Director of Engineering of the Curtiss-Wright Corporation.

In 1940, Mr. Wright was a member of the National Defense Council Advisory Committee on the American Aircraft Industry. He became Assistant Chief of the Aircraft Branch of the Office of Production Management, and in 1943 was made Director of the Aircraft Resources Control Office of the Aircraft Production Board. He has been Administrator of the Civil Aeronautics Administration since 1944 and, in 1945, was elected Vice-Chairman of the National Advisory Committee for Aeronautics.

He was awarded the Wright Brothers Medal of the Society of Automotive Engineers for 1931 and, in 1945, received the Army's Commendation for Exceptional Service, the War Department's highest award to civilians.

The Sylvanus Albert Reed Award

Charles S. Draper, Professor of Aeronautical Engineering in Charge of Instrumentation at the Massachusetts Institute of Technology, was selected to receive The Sylvanus Albert Reed Award for 1945.

The Award is given annually by the Institute for a notable contribution to the aeronautical sciences resulting from experimental or theoretic investigations, the beneficial influence of which on the development of practical aeronautics is apparent. It was endowed in 1933 through a bequest of $10,000 by the late Dr. S. A. Reed.

Presentation of the Award to Professor Draper was made by Dr. Hugh L. Dryden, Assistant Director of the National Bureau of Standards.

Professor Draper was graduated from Stanford University in 1922 with a B.A. degree and, from the Massachusetts Institute of Technology, received the degrees of B.S. in Electrochemical Engineering in 1926, M.S. in Aeronautical Engineering in 1928, and D.Sc. in Physics in 1938. He was commissioned a Second Lieutenant in the U.S. Army Air Corps Reserve in 1926 and was later promoted to First Lieutenant. In 1927, he established and operated a laboratory to develop infrared signalling devices for the U.S. Navy. He joined the staff of the Massachusetts

Charles S. Draper.

Institute of Technology in 1929 as a Research Assistant in Aeronautical Engineering, becoming Research Associate in 1930, Associate Professor in 1938, and Professor in 1939. In his work at M.I.T., he has been actively engaged in teaching and research in the field of aeronautical instruments and is the author of many scientific publications on this subject. He has served as consultant to the National Advisory Committee for Aeronautics and to leading aircraft manufacturers.

The Thurman H. Bane Award

Capt. Myron Tribus, of the Equipment Laboratory, Air Technical Service Command, Wright Field, was the recipient of The Thurman H. Bane Award for 1945. Presentation of the Award was made by Hon. William A. M. Burden, Assistant Secretary of Commerce for Air.

The Award was established in 1942 by Major R. H. Fleet, Past-President of the Institute, and is given to an officer or civilian of the Army Air Forces Matériel Command (now the Air Technical Service Command) for an outstanding achievement in aeronautical development.

Captain Tribus was graduated with honors from the University of California in 1942 and was the recipient of many scholarship awards, including the appointment as the La Verne Noyes Scholar for 1939–1940, the Otto Henry Greenewald Memorial Scholar for 1940–1941, and the Isias W. Hellman Scholar for 1941–1942. In 1941, he was elected President of the University of California Honor Students Association. While at the University, he wrote three reports that were published by the National Advisory Committee for Aeronautics.

He entered the U.S. Army Air Forces in July, 1942.

In the course of his research work in the Army Air Forces, Captain Tribus secured valuable data that served to reduce the icing hazard of high-speed flying.

Capt. Myron Tribus.

Lt. Col. Harry Wexler.

The Robert M. Losey Award

Lt. Col. Harry Wexler, Chief of the Special Scientific Services Division, U.S. Weather Bureau, was the recipient of The Robert M. Losey Award for 1945. It was conferred by Dr. F. W. Reichelderfer, Chief of the U.S. Weather Bureau.

An annual presentation, the Award was established by the Institute in 1940 to honor the memory of Capt. Robert Moffat Losey, an American Air Corps officer who was killed in Norway on April 21, 1940, while serving as an official meteorologic observer for the U.S. Army. He was the first United States officer killed in World War II. The Losey Award is made in recognition of outstanding contributions to the science of meteorology as applied to aeronautics.

Having been graduated from Harvard College in 1932 with the degree of Bachelor of Science, Lieutenant Colonel Wexler attended the Massachusetts Institute of Technology from 1932 to 1934. Reentering this institution in 1937, he received the degree of Doctor of Science in Meteorology in 1939. He joined the U.S. Weather Bureau in 1934 as a weather forecaster and research meteorologist but was given leave in 1940 to accept an assistant professorship at the University of Chicago to instruct Army, Navy, and civilian students in meteorology.

After rejoining the Weather Bureau in 1941, he was commissioned a captain in the U.S. Army in 1942, serving in research and instruction capacities at the U.S. Army Weather School at Grand Rapids, Mich., and the Weather Division, Headquarters Army Air Forces.

In July, 1945, he became Chief of the Development Branch, Headquarters A.A.F. Weather Service at Asheville, N.C. Leaving the U.S. Army on January 4, 1945, he rejoined the U.S. Weather Bureau in his present capacity on January 7.

The Octave Chanute Award

Robert T. Lamson and A. Elliott Merrill, Test Pilots in the Engineering Division of Boeing Aircraft Company, were chosen as co-recipients of The Octave Chanute Award for 1945, given annually for notable contributions made by a pilot to the aeronautical sciences.

The Award honors the memory of the American engineer, Octave Chanute, who died in 1910. He was a pioneer in aeronautical research and gave assistance and advice to the Wright Brothers in their early work.

William Littlewood, Vice-President in Charge of Engineering of American Airlines, Inc., made the presentation. Mr. Merrill accepted for Mr. Lamson and himself.

Mr. Lamson was graduated from the University of Washington in 1936 and won a scholarship at the Boeing School of Aeronautics, where he engaged in engineering and flight study. In 1939, he was commissioned a Second Lieutenant in the U.S. Army Air Corps as a fighter pilot. He became a flight instructor of Army cadets at Cal-Aero

A. Elliott Merrill.

Robert T. Lamson.

Academy in California in 1940. He joined the Boeing company as Engineering Test Pilot in January, 1941.

Mr. Merrill received a degree in electrical engineering from the University of Washington in 1926. While at the University he earned his commission in the U.S. Army Air Corps Reserve. In 1928 he, with a partner, organized and operated the Washington Aircraft and Transport Corporation. He continued in commercial flying enterprises until the outbreak of World War II, when he joined the flight-test group at Boeing.

At the Boeing company, Messrs. Lamson and Merrill secured flight research data that contributed materially to increasing the ceiling of four-engined bombardment airplanes.

The Lawrence Sperry Award

Richard Hutton, Chief Development Engineer of Grumman Aircraft Engineering Corporation, was chosen to receive The Lawrence Sperry Award for 1945. It is given annually for a notable contribution made by a young man to the advancement of aeronautics.

Established in 1936, the Sperry Award was endowed by the sister and brothers of the late Lawrence Sperry, pioneer aviator and inventor, who drowned at the age of 31 as a result of a forced landing in the English Channel in 1923.

Presentation of the award was made by Rear Adm. Luis de Florez, U.S.N.R., Assistant Chief of the Office of Research and Inventions.

A graduate of the New York City public schools and the Pratt Institute, Mr. Hutton joined the Loening Aeronautical Engineering Corporation in 1928. He became associated with Grumman Aircraft Engineering Corporation in 1930 as a Draftsman. From 1930 to 1937 he advanced to the positions of Layout Man and Project Engineer, assuming his present post as Chief Development Engineer in 1940. In this capacity, Mr. Hutton was largely responsible for the development of carrier-based aircraft used extensively by the Naval Air Forces in the conquest of Japan. Included among the developments for which he is credited are the "Wildcat" (F4F), "Avenger" (TBF), "Hellcat" (F6F), "Tigercat" (F7F) and "Bearcat" (F8F).

Richard Hutton.

The John Jeffries Award

Commodore John C. Adams, Chief of the Division of Aviation Medicine, Bureau of Medicine and Surgery, Navy Department, was selected to receive The John Jeffries Award for 1945, given annually for outstanding contributions to the advancement of aeronautics through medical research.

The Award honors the memory of Dr. John Jeffries, an American physician who, with Blanchard, the French balloonist, made the first aerial voyage across the English Channel in 1785. It was established by the Institute in 1940 to give recognition to the importance to aviation of scientific endeavor in the field of medicine.

Presentation of the award to Commodore Adams was made by Dr. Eugene F. DuBois, Chairman, Committee on Aviation Medicine, National Research Council.

Commodore Adams received his M.D. degree from the University of Alabama in 1917. In the same year, he was commissioned a Lieutenant (j.g.) in the Medical Corps of the U.S. Navy. He served with the Marines during the first World War and at the close of the war was assigned to the hospital ship "Mercy." His sea duty also included assignments aboard the aircraft carrier "Langley"; on the Staff of Commander, Aircraft Squadrons, Pacific; and on the cruiser "Quincey." In 1923, he completed training as a flight surgeon at the Army School of Aviation Medicine at Mineola, L.I., and since that time his interests have been primarily in aviation activities.

Since 1936, Commodore Adams has been Chief of the Division of Aviation Medicine, Navy Department. During his period of administration, this organization was expanded until it became numerically larger than the entire naval medical establishment prior to the outbreak of World War II. He was a pioneer in helping to establish a Division of Medical Research in the Bureau of Medicine and Surgery. He helped in the original planning and development of the National Naval Medical Center at Bethesda, Md. He initiated and was primarily responsible for the establishment of the Physiological Research Unit at the Naval Air Material Center, Philadelphia; the Physiological Flight Test Unit at the Naval Air Test Center, Patuxent River, Pa.; and the School of Aviation Medicine and the Aviation Medicine Research Unit, both at Pensacola, Fla.

Fellowships of the Institute

Fellows of the Institute are proposed and elected by Honorary Fellows and Fellows of the Institute residing in the United States. It is required that a Fellow shall have attained a position of distinction in aeronautics and shall have made notable and valuable contributions in one of the aeronautical sciences or aeronautical engineering. Not more than ten Fellows residing in the United States and ten Fellows residing in foreign countries may be elected each year.

Commodore John C. Adams.

The following ten Associate Fellows of the Institute were elected Fellows: Col. Harry G. Armstrong, U.S. Army Air Forces; Harry Bateman, Professor of Aeronautical Mathematics and Theoretical Physics, California Institute of Technology; Lt. Comdr. William Bollay, Bureau of Aeronautics, Navy Department, on leave from the Graduate School of Engineering, Harvard University; Kenneth Campbell, Senior Project Engineer, Wright Aeronautical Corporation Division of Curtiss-Wright Corporation; Franklin R. Collbohm, Assistant to Vice-President of Engineering, Douglas Aircraft Company, Inc.; Harold R. Harris, Vice-President and General Manager, American Overseas Airlines, Inc.; John C. Leslie, Vice-President of Transatlantic Operations, Pan American Airways, Inc.; John R. Markham, Associate Professor of Aeronautical Engineering, Massachusetts Institute of Technology; Sanford A. Moss, Consulting Engineer, Supercharger Engineering Division, General Electric Company; Frank L. Wattendorf, Senior Aeronautical Engineer, U.S. Army Air Forces.

General Arnold Receives Two Decorations

In separate citations, General of the Army H. H. Arnold, Commanding General of the U.S. Army Air Forces and an Honorary Fellow of the Institute, has been awarded two Oak Leaf Clusters to the Distinguished Service Medal for his organization and leadership of the Army Air Forces. The presentation was made at the White House by President Truman, who said of General Arnold that "he fulfilled his mission in a manner that overwhelmed this nation's enemies and awed its Allies," and that "he is a

HANGAR FLYING

LOCKHEED

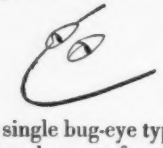
6 Designs for a Windshield

The people in the Engineering Research building at Lockheed, Factory B-1, Burbank, point out that the unique windshield design on the *Constellation* didn't just happen. Five experiments preceded it.

Windshield No. 1 went into a completely faired nose. It looked good on paper, but when it was mocked up Lockheed found that vision for pilots was bad.

Type 2 was an attempt to put the crew "downstairs". This turned out to be a failure because it would have been pretty uncomfortable in a belly landing. This is the way it looked:

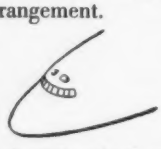
The engineers next tried two small bug-eyes, which were successful only in giving the crew claustrophobia. Discard No. 3:



A wide, single bug-eye type was tried next, but was found difficult for pressurization.

Fifth was a conventional "Vee" windshield, but the fuselage was too big to allow for an effective design.

The sixth windshield was adopted. Besides being the lightest of all, its many small panels give excellent vision angle as well as convenient control and instrument arrangement.



This kind of inspired persistence is going on all the time at Lockheed—the kind that makes good planes and good telling.

L to L for L

©1946, Lockheed Aircraft Corp., Burbank, Calif.

shining example of what this great nation could do under superior leadership."

Present at the ceremonies were the heads of service branches, Cabinet officers, and several hundred members of the armed forces.

Dr. Dryden Assumes Additional Post

Dr. Hugh L. Dryden, Past-President and Honorary Fellow of the Institute, has been appointed Assistant Director of the National Bureau of Standards, in addition to his post as Chief of the Bureau's Division of Mechanics and Sound. Dr. Dryden's appointment follows 26 years of service in the Bureau, distinguished by many outstanding accomplishments in the field of aerodynamics. He was the recipient of The Sylvanus Albert Reed Award for 1941, given "for a notable contribution to the aeronautical sciences resulting from experimental or theoretical investigations, the beneficial influence of which on the development of practical aeronautics is apparent."

Brig. Gen. Harold R. Harris Awarded Legion of Merit

Brig. Gen. Harold R. Harris, former Commanding Officer of the Domestic Transportation Division of the Air Transport Command, and now Vice-President and General Manager of American Overseas Airlines, Inc., has been awarded the Legion of Merit. The presentation was made in Washington by Lt. Gen. Harold R. George, Commanding General of the Air Transport Command. General Harris is one of the newly elected Fellows of the Institute.

The citation reads: "For exceptional meritorious conduct in the performance of outstanding service as Commanding Officer, Domestic Transportation Division, A.T.C., from March 15, 1943, to October 10, 1943. Colonel Harris' efficient guidance of the numerous complicated training and air-cargo activities of the Domestic Transportation Division, A.T.C., made possible effectual and full utilization by the A.T.C. within the domestic United States of facilities of civil commercial air lines under contract to the War Department. Colonel Harris' exceptionally brilliant insight into the many factors involved in transitional transport and operational training of officers and enlisted men was reflected in the splendid results obtained. His executive abilities with regard to aircraft operation resulted in widespread improvement in the domestic air cargo service of the A.T.C."

Corporate Members Receive Awards

The Research Laboratory of the Curtiss-Wright Corporation has been designated to receive the Naval Ordnance Development Award, for "distinguished service to the research and development of naval ordnance."

This award was established by the Navy Bureau of Ordnance to recognize exceptional services of organizations and civilians in the research and development of naval ordnance since December 7, 1941.

In addition to the certificate which will be given to the Research Laboratory, the Bureau of Ordnance will also present certificates for exceptional service to those who performed important services on the various projects undertaken by the Laboratory. Lapel pins will be awarded to all employees who have been associated with the work.

Eastern Air Lines, Inc., has received the 1945 Maintenance and Performance Award for lines operating more than 10,000,000 revenue-miles given by the magazines *Aviation* and *Air Transport*.

Corporate Members Expand

The B. F. Goodrich Company has announced plans to construct a new plant near Marietta, Ohio, for the processing of plastics. The project will involve an investment of approximately $4,000,000.

The new plant will be located on a 66-acre tract of land and will consist of a main building with a floor area of 112,000 sq.ft., and auxiliary and service buildings having 48,000 additional sq. ft. The processing of plastics at this plant will supplement the development and production of plastics, rubber, and synthetic rubber now carried on by The B. F. Goodrich Company.

On completion, the plant is expected to require about 250 employees. Only a small staff of supervisory, technical, and scientific men will be transferred to Marietta, all other personnel to be newly employed in the area of the new plant.

Northrop Aircraft, Inc., has acquired Salsbury Motors, Inc., of Los Angeles, manufacturers of 6-hp. air-cooled engines, an automatic clutch and transmission, and motor scooters. The transaction was accomplished through an exchange of stock.

Originally formed as Avion, Inc., in 1942, the company was engaged in aircraft assembly work during the war. In the autumn of 1944, Avion acquired exclusive manufacturing rights for Salsbury products and since then has developed additional designs. In November the company assumed its present name.

One of the company's current developments is its power turret, a compact unit housing a Salsbury engine, automatic clutch and transmission, and a driving wheel, used to operate a line of industrial trucks. Also in production is the Salsbury "600," a 6-hp. industrial engine, developing 1 hp. for each 8.4 lbs. of its weight, and currently being used to power the company's motor scooters, now in production.

The acquisition of the Salsbury subsidiary completes Northrop's current postwar expansion program.

Curtiss-Wright Presents Research Laboratory to Cornell University

Curtiss-Wright Corporation, a Corporate Member of the Institute, has completed arrangements to present its research laboratory and wind tunnel at Buffalo, N.Y., to Cornell University. It will be known as the Cornell Aeronautical Laboratory. The presentation will facilitate a cooperative research-educational program supported by a number of Eastern aircraft manufacturers.

Erected in 1942, the research laboratory contains modern scientific and testing devices for aeronautical research. Outstanding among these is the wind tunnel, where scale airplane models can be tested in air velocities in the speed of sound range under varying pressure conditions. Other facilities include miniature wind tunnels; a large altitude chamber; static and structural testing equipment; a model shop; a technical library; and chemistry, physics, hydraulic, and electrical laboratories. A recent development of the research laboratory is a telemetering system which permits performance data of an object in flight to be recorded and studied at a mobile receiving unit while the flight is in progress.

Dr. C. C. Furnas, Director of the Research Laboratory for Curtiss-Wright Corporation, will remain in Buffalo to direct the activities of the Laboratory for the university. It is intended that all graduate students in aeronautics at Cornell's Engineering College divide their time between the campus at Ithaca and the laboratory at Buffalo.

Sections and Branches

Detroit Section

On December 13 a meeting was held in The Horace H. Rackham Educational Memorial Building, under the chairmanship of Arthur A. Locke. The election of Peter Altman as Representative to the Nominating Committee for Area Councilors and his nomination as an Area Councilor were announced. E. H. Vaillencourt, of Consolidated Vultee Aircraft Corporation, presented a paper titled "Aircraft Surface Development." The speaker emphasized the importance of surface development to designers, discussing methods of creating smooth flowing curves and proper fairing of aircraft, as well as improving the appearance.

The talk was illustrated by blackboard solution of typical problems to show the application of proportional keys. The problems were based on graphical solution of the formation of complementary curves.

At the next meeting R. F. Ternes, Patent Attorney, with the U.S. Rubber Company, will speak on "Patents and Aircraft."

Los Angeles Section

On November 30 the Los Angeles Section held a dinner meeting which was attended by 275 members. The annual reports of the Secretary and the Treasurer were read. The Secretary's report disclosed that the financial position of the Section had improved over its 1944 status, because of the financial aid given by Institute headquarters in New York. In a discussion of the new Section building, the architect's drawings were displayed and explanations were given of certain revisions that had been made to reduce the floor area and costs. Chairman Arthur E. Raymond presented a list of all organizations that had contributed to the building fund and reported an itemized building budget, showing that the fund exceeded the budget by approximately 10 per cent. A motion was carried for approval of the plans and for the preparation of working drawings.

With regard to operation of the new Section building, the Chairman disclosed that approximately $35,000 a year would be required, of which $20,000 would be used for the library. Companies supporting the library are committed for 6 months at a time and an attempt will be made in the near future to obtain long-range commitments. There will then remain $15,000 a year to be obtained through corporate contributions, allocation of national funds, and Section dues. In a discussion period, three-fourths of the members present agreed to consider Section dues and indicated a preference for the amount of $5 per year.

J. Richard Goldstein, Chairman of the Nominating Committee, nominated for office the following members, who were unanimously elected: Chairman, Clarence L. Johnson, Chief Research Engineer, Lockheed Aircraft Corporation; Vice-Chairman, E. H. Heinemann, Chief Engineer, El Segundo Plant, Douglas Aircraft Company, Inc.; Secretary, George R. Mellinger, Chief Flight Test Engineer, North American Aviation, Inc.; Treasurer, Nevin Schwien, President, L. N. Schwien Engineering Company; and Representative on the Nominating Committee for Area Councilors, F. R. Shanley, Division Engineer, Engineering Research, Lockheed Aircraft Corporation.

Dr. W. B. Klemperer, Research Engineer, Douglas Aircraft Company, Inc.; Dr. F. G. Malina, Assistant Professor, California Institute of Technology; and Ward Beman, of Lockheed Aircraft Corporation talked on "European Aeronautical Developments." The three speakers gave eyewitness account of European developments, which they illustrated with motion pictures.

New York Section

At a meeting of the New York Section, held on December 10 in the McGraw-Hill Building auditorium, aspects of the German aircraft effort were discussed by two Institute members recently returned from technical missions to Germany. Otto E. Kirchner, Director of Aircraft Engineering of American Airlines, Inc., spoke on "German Air Transport," and Louis H. Enos, Assistant Chief Engineer, Curtiss Propeller Division of Curtiss-Wright Corporation, presented "German Application of Rocket and Jet Propulsion."

Mr. Kirchner exhibited lantern slides of German airports and scenic views encountered on his journey. He pointed out the merits and flaws of the airports visited and stressed the extreme effort put forth by the government to keep the German people air-minded, as evidenced by the design of airports as showplaces and the encouragement given to attendance at air meets. Some of the material not yet having received the necessary clearance, Mr. Kirchner promised further data when clearance has been obtained.

Although difficulty was encountered because a good part of the German equipment had been reduced to rubble, Mr. Enos gathered photographs and specifications of much of the work done by the Germans in rocket and jet propulsion. Lantern slides of designs and performance data were shown, with the explanation that, though pressed for time, the Germans actually did get some of these models into the operational stage and used them in combat with varying degrees of success.

High speeds and high rate of climb featured almost all the German models. Severely swept-back and swept-forward wings were prominent, as well as the consistently small size of the airplanes and engines. According to Mr. Enos, the German efforts showed indications of eventual success had the war not ended when it did.

Mr. Enos answered questions from the floor in a discussion period following his address. Chairman Jerome Lederer presided.

Philadelphia Section

On December 6 the Philadelphia Section held a committee meeting at which S. L. Gavel, General Manager of Superior Tube Company, was nominated as Area Councilor, and Richard Prewitt, Vice-President in Charge of Engineering of Kellett Aircraft Corporation, as Alternate. In a discussion of general procedures which followed, the question of a location for the monthly meetings was taken up. The Franklin Institute and the Engineers' Club of Philadelphia are the locations under consideration and decision is to be withheld until April or

May. It was suggested that active discussion of papers be arranged for by the authors of the papers and members of the Section, and that preprints be forwarded to selected discussers at least 1 week before the meeting. R. A. Booker, Jr., Group Supervisor, Kellett Aircraft Corporation, was appointed Vice-Chairman of the Papers and Meetings Committee to assist Chairman Ludwig B. Kalinowski.

A meeting held in the Engineers' Club of Philadelphia on December 18 dealt further with general procedure and committee duties. It was decided that meetings for which the speakers are having preprints prepared shall be announced by letter to the members well in advance of the meeting, so that members desiring preprints may have sufficient time to request them from the author by mail prior to the meeting.

The duty of the Liaison Committee was stated to be to inform the Section Secretary of the meetings of other organizations at which attendance would be desirable for Section members. The following were appointed to the Liaison Committee: Harris S. Campbell, W. H. Pearson, John Rogers, Francis G. Tatnall, John S. Kean, Leon L. Douglas, and Harold W. Davis. Mr. Kean was also appointed Chairman of the Nominating Committee for Section Officers.

The speaker for this meeting was Robert L. Lichten, Aerodynamicist, of Kellett Aircraft Corporation. His paper "Helicopter Performance" presented a method for calculating helicopter performance using a blade-element approach.

Performance was expressed in terms of the climb ratio and charts were presented expressing the flight performance with comparisons of actual helicopter performance with calculated results. That preprints used during the talk proved helpful in enabling the members to follow the technical parts of the paper was evidenced by the discussion period following the talk.

Seattle Section

On November 28 the Seattle Section held a dinner meeting in the Chamber of Commerce Building. The principal speaker was Thomas E. Jermin, Supervising Forecaster in the Seattle office of the U.S. Weather Bureau, whose subject was "Development of Meteorology and Its Relationship to Airway Traffic." Following Mr. Jermin's talk, the U.S. Navy motion picture *Flying the Weather Map* was shown.

At a dinner meeting on January 8, A. F. Kelsey, Project Engineer at Boeing Aircraft Company, gave a talk on "Tomorrow's Airplane Today—The Boeing 377 Stratocruiser." R. L. Linforth, Group Engineer, Boeing Aircraft Company, addressed the group on "Design Considerations for Cabin Air-Conditioning System of the Boeing Stratocruiser." The color film *Tomorrow's Airplane Today* was shown.

Washington Section

Comdr. Dayton A. Seiler, U.S.N., addressed the Washington Section at a meeting held on December 5 in the U.S. Chamber of Commerce Building. His subject was "German Rocket Development." Recently returned from a study of this subject in Germany, Commander Seiler opened his address by showing pictures of German jet units on test stands, the Me 163 jet-propelled aircraft in flight, and other jet and rocket developments that he witnessed. He gave a historical account of German rocket development, including considerable information about the V-2 rocket. Slides were shown, followed by a discussion period. Commander Seiler did not submit his paper for publication because much of the material is not yet available for release.

University of Detroit

At a meeting held on December 6 the film *Wings of the Army* was shown. Douglas Allison, Branch Chairman, presided.

Georgia School of Technology

On December 6 a meeting was held in the Aeronautics Building, at which Professor La Vere spoke. His subject was "Structure Problems." William J. Oakes, Jr., Branch Chairman, presided.

On December 18 a technical meeting was held under the chairmanship of John K. Wimpress, Branch Vice-Chairman. Prof. George K. Williams gave a talk titled "Development of the P-38," which was illustrated by the film *The Lightning P-38*.

Illinois Institute of Technology

The election of officers for the new term took place at a meeting of the Branch on December 7. Those elected were Allan Kukral, Chairman; Jacob Kramer, Vice-Chairman; and Thomas Feehery, Secretary-Treasurer. Dr. Charles O. Harris, Faculty Adviser of the Branch, spoke briefly about the Institute for the benefit of the new men present.

University of Illinois

An organization meeting was held January 3 to inaugurate a Student Branch of the Institute at the University of Illinois. Prof. R. W. McCloy (formerly Faculty Adviser of the Student Branch at the University of Kansas) is Honorary Chairman. The following officers were elected: Chairman, Leland C. Schubert; Vice-Chairman, Allan I. Ormsbee; Secretary-Treasurer, Albert D. Swanson.

Two motion pictures were shown at the meeting, *The Lightning P-38* and *Construction of a Light Airplane*.

Massachusetts Institute of Technology

A business meeting was held on December 3 in the Graduate House, under the chairmanship of Bernard J. Haverback. The purpose was to acquaint the new officers with their duties and the structure of the organization. The Chairman gave an explanatory talk about subscriptions to Institute publications, Technical Membership, and The Paul Kollsman Library. The Secretary-Treasurer, Herbert E. Jacques, read the Treasurer's report.

On December 11 the members visited the plant of the Pratt & Whitney Aircraft Division of United Aircraft Corporation in Hartford, Conn. The group was led by Secretary-Treasurer Herbert E. Jacques and was accompanied by Prof. Charles F. Taylor. The members were conducted by junior engineers of the company through the research buildings and were shown the wind tunnel, the details of the model balance, and the central control room. The group also observed the various cells for testing at standard atmosphere, reduced pressures, and sub-zero temperatures, and were shown a full power (4,400 hp.) propeller test of the Wasp Major engine.

At the next meeting Prof. Otto C. Koppen will speak on private flying.

New York University

A business meeting was held on December 4 in the Guggenheim Building, under the Chairmanship of Martin Snyder. The members voted to donate subscriptions of the JOURNAL OF THE AERONAUTICAL SCIENCES and the AERONAUTICAL ENGINEERING REVIEW to the Gould Memorial Library. A discussion of future social events followed.

On December 18 a technical meeting was held, at which the films *Wings Over Dixie* and *Construction of a Light Plane* were shown.

University of Tulsa

On December 13 a combined business and technical meeting was held in the Phillips Engineering Building, under the chairmanship of Adolf E. Kowalski. William Boyd was named Publicity Representative for the Branch, his duties being to notify local newspapers of important meetings and to contact high school groups that would be interested in the Branch's program, since some of the Tulsa high schools offer courses in aeronautics. The motion was made by Mr. Boyd that the Executive Committee divide the membership into groups of three, each group to be responsible for one monthly meeting, and the Secretary of the Branch to be an ex-officio member of each group. The motion was carried. The University of Oklahoma visual education film *Aerodynamics—Air Flow* was exhibited.

News of Members

Robert C. Bartels has joined the faculty of the University of Michigan as Assistant Professor of Mathematics.

Archibald Black is now with the Provisional International Civil Aviation Organization, to do organization work.

Vincent E. Caswell has joined the Aircraft Division of Universal Moulded Products Corporation.

David P. Chappell is now a Stress Analyst with Tennessee Aircraft, Incorporated.

Henry L. Child has been appointed Executive Secretary to the Advisory Committee on Non-Scheduled Flying of the Civil Aeronautics Administration.

Alexander C. Crossman has become a Senior Mechanical Engineer at Packard Motor Car Company.

Robert M. De Witt has joined Edo Aircraft Corporation as a Stress Analyst.

Capt. Thomas B. Doe has been elected President of the Sperry Corporation. He had been Vice-President since 1934.

Egan D. Foy has transferred to the Columbus Plant of the Curtiss-Wright Corporation as a Design Engineer.

Undersecretary of the Navy Artemus L. Gates has received President Truman's acceptance of his resignation, submitted September 2 but deferred at the President's request until December 31. He is expected to return to private business.

Harold J. Harmer is now a Structural Test Engineer at the Wichita Division of Boeing Aircraft Company.

James T. Harris is now with Goodyear Aircraft Corporation as a Senior Stress Analyst.

Sherman M. Fairchild, Chairman of the Board of Fairchild Engine & Airplane Corporation, will direct the research activities of the company's Personal Planes Division.

Alfred Marchev, President of Republic Aviation Corporation, has been elected to the additional post of Director of General Precision Equipment Corporation.

Clyde B. Johnson has joined the Fort Worth Division of Consolidated Vultee Aircraft Corporation as an Aerodynamicist.

Robert E. Johnson has completed his service in the U.S. Navy and has assumed the post of Director of Advertising and Publicity for United Air Lines, Inc.

Julius Jonas has joined Northrop Aircraft, Inc., as Aerodynamics Engineer.

Norman Jump is now with the National Cash Register Company as Process Engineer.

Ralph A. Kindler has joined Northrop Aircraft, Inc., as Stress Analyst A.

Ervin T. Kisselberg has become a Stress Engineer at McDonnell Aircraft Corporation.

Nelson G. Kling is now a partner in the Airol Engineering and Manufacturing Company.

Edwin C. Kluga has become a Layout Draftsman with Bell Aircraft Corporation.

George L. Lentz has joined the Menasco Manufacturing Company as Gas Turbine Engineer.

Chia-Chiao Lin has joined the faculty of Brown University as Assistant Professor.

Col. Robert M. Love, formerly Deputy Chief of Staff of the Air Transport Command, has become President of All American Aviation, Inc.

Neil J. Mackenzie is now with the Helicopter Division of Bell Aircraft Corporation as Project Stress Engineer.

Harry M. McKay has been named Head of the Personal Planes Division of Fairchild Engine & Airplane Corporation.

Major Gen. Clements E. McMullen, former Commander of the Far East Air Service Command, has been appointed Chief of Staff of the Pacific Air Command of the U.S. Army.

Capt. Thomas J. May has been appointed General Manager of Robinson Airlines Division of Robinson Aviation, Inc.

Vice Admiral Marc A. Mitscher, former Deputy Chief of Naval Operations for Air, has been named Commander of the U.S. 8th Fleet.

William J. Nemerever has joined Curtiss-Wright Corporation as an Aerodynamicist.

Virgil Nespolo, Jr., is now an Engineering Designer with Northrop Aircraft, Inc.

Lt. Comdr. Harold E. Perrin has resigned as Secretary of the Royal Aero Club of Great Britain.

Alex Petrovsky has joined Republic Aviation Corporation as Aerodynamics Engineer.

L. Welch Pogue has accepted appointment for the fifth term as Chairman of the Civil Aeronautics Board.

Peter H. Redpath is on leave of absence from Transcontinental and Western Air, Inc., to serve as Operations Manager for Sila Swedish Airline.

Carl N. Sanford has joined the faculty of Iowa State College as Assistant Professor of Aeronautical Engineering.

Lt. Col. Charles A. Sanford has become Superintendent of the Aviation Department of the Indemnity Insurance Company of North America.

Thomas A. Morgan has been elected Chairman of the Board of the Sperry Corporation. He had previously been President and a Director.

Adm. John H. Towers, former Commander of the U.S. 5th Fleet, has been assigned as Commander in Chief of the Pacific Fleet and Pacific Ocean areas.

Martin D. Saslaw is now an Instructor in Structural Analysis at the Spartan College of Aeronautical Engineering.

Wilbert Schwartzapfel has joined Stratos, Inc., as Project Engineer.

Ira Shur is now Chief Draftsman at Waldes Kohinoor, Inc.

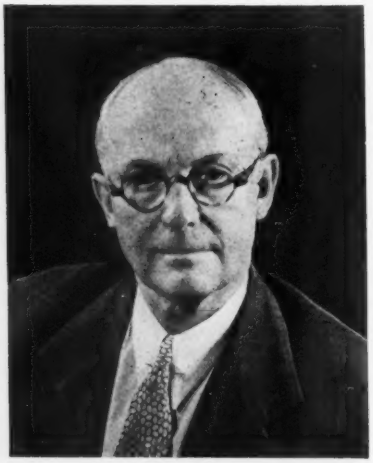
Clyde W. Smith has been appointed Schedule and Tariff Agent of Pan American Airways.

John S. Smith has been elected Chairman of the Board of Wings Field, Inc.

Lee H. Smith has been appointed Sales Director of the Personal Planes Division of Fairchild Engine & Airplane Corporation.

Maks A. Stajich is now a Consulting Engineer to American Export and Import, Inc.

Antoni Taranek has become a Structural Engineer with Canadair, Ltd.



Col. Jesse G. Vincent has been elected a Director of the Packard Motor Car Company, in addition to his post as Vice-President in Charge of Engineering.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Biddlecombe, Conrad Herbert, Director, Armament and Equipment Supply, British Air Commission (Washington, D.C.).

Czerwinski, Waclaw, Chief Engineer, Canadian Wooden Aircraft Ltd. (Canada).

Hall, Newman Arnold, Ph.D.; Mechanical Engineer, United Aircraft Corp.

Keen, Walter Hughes, Jr., B.S. in M.E.; Comdr., U.S. Navy.

Loughridge, Donald Holt, Ph.D.; Prof. of Physics, University of Washington.

Sporleder, Ernest Bassett, B.S. in Ae.E.; Administrative Engineer, Douglas Aircraft Co., Inc.

Whitman, Ray Palmer, Vice-President in Charge of Sales, Bell Aircraft Corp.

Elected to MEMBER Grade

Balasubramanian, Sankaranarayana Iyer, B.Sc. (Engineering); Supervisor, Production Dept., Hindustan Aircraft Factory (India).

Bouley, Noel Warner, B.Ae.E.; Chief Div. Engineer, Consolidated Vultee Aircraft Corp.

Brewer, Given, B.S.; Consulting Engineer.

Colcord, William Henry, Designer and Administrative Engineer, Kellett Aircraft Corp.

Cushman, Thomas Austin, Chief Experimental Pilot, Republic Aviation Corp.

Davies, Robert Henry, B.S. in M.E.; Technical Service Manager, The Parker Appliance Co.

Eringen, Ahmed Cemal, M.Sc.; Structural Design Engineer, Etimesgut Aircraft Factory (Turkey).

Friesinger, Rudolf, C.E.; Stress Analyst, G & A Aircraft Inc.

Ghaswala, Soli Kaikobad, B.C.E.; Technical Asst., Public Works Dept., Government of Bombay (India).

Goodier, James Norman, Ph.D.; Prof. of Mechanics, Cornell University.

Griffin, John Ralph, Jr., M.S.; Supervisor of Engineering, International Div., Transcontinental & Western Air, Inc.

Grundy, Douglas Hilton, Squadron Leader, Royal Air Force (England).

Harman, Roderick Frank, Wing Commander, Deputy Chief, Navigation and Instrument Branch, British Air Commission.

Hebert, R. J., B.C.E.; Technical Office Supervisor, Canadair Ltd. (Canada).

Hohenschau, Adalbert Merwin, B.S.; Teacher—Airplane Design, Aeronautical University.

Horvay, Gabriel, Ph.D.; Research Engineer, McDonnell Aircraft Corp.

Johnson, Roscoe Hilton, Jr., Lt. Col., Regional Safety Officer, U.S. Army Air Forces.

Kupiec, Harry Peter, B.S. in Ae.E.; Director, Air Associates Inc.

Lane, Frank Bertram, M.E.; Chief Engineer, Turret Div., Engineering & Research Corp.

Lee, Yuan Chuen, B.S. in Ae.E.; Structures Engineer, Consolidated Vultee Aircraft Corp.

Liljengren, Curtis Paul, B.Ae.E., B. of Business Admin.; Dc-3A Aircraft Project Engineer, Pan American Airways System.

Lynn, Stanley, A.B., M.E.; Manager, Gas Turbine and Gear Sales, Joshua Hendy Iron Works.

Masefield, Peter Gordon, M.A.; British Civil Air Attaché, British Embassy (Washington, D.C.).

Matthaeus, Alfred Henry, B.S. in M.E.; Major, U.S. Army Air Forces.

Mattison, John Albert, B.S. in E.E.; Project Engineer, Curtiss-Wright Corp.

Montgomery, Edwin Jones, Sr., B.S.; President, Arizona Airlines, Inc.

Moody, Arthur M. G., M.E.; Chief Blower Engineer, Elliott Company.

Nobbs, Albert Russel, B.A.Sc., P.Eng.; Managing Engineer, Meter Dept., Canadian General Electric Co. Ltd. (Canada).

Noyes, Fred Leigh, B.S.; Sr. Stress Analyst, The Glenn L. Martin Co.

Noyes, John, Jr., B.S. in M.E.; Group Leader—Engr. Dept., McDonnell Aircraft Corp.

Patecell, Theodore Curvin, Air-line Pilot, Pan American Airways System.

Poole, Harmon Atkinson, S.B.; Assistant General Manager, Bendix Aviation Corp.

Posner, Ezra C., M.S., M.E.; Aerodynamics Engineer, Lockheed Aircraft Corp.

Powell, Clarence Henry, Sc.D., M.E.

Reed, John Milton, Production Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Rohrer, William Glen, B.A.; Chief Ground Instructor, Riverside Flight Academy, Inc.

Runyon, Donald Eugene, Lt., Test Pilot, U.S. Navy and N.A.C.A.

Shelesnyak, M. C., Ph.D.; Aviation Physiologist, U.S. Navy.

Stewart, James, Chief Engineer and Manager, Aviation Dept., Vacuum Oil Co., Pty, Ltd. (New Zealand).

Storms, Harrison A., Jr., B.S. in Ae.E.; Asst. Chief Aerodynamicist, North American Aviation, Inc.

Trimmer, John Dezendorf, Ph.D.; Physicist, Clinton Engineer Works, Tennessee Eastman Corp.

Williams, Glenn C., Sc.D.; Asst. Prof.—Chemical Engineering, Mass. Institute of Technology.

Transferred to MEMBER Grade

Arrigo, Vincent Paul, B.S. in M.E.; Sr. Engineer, Curtiss-Wright Corp.

Chesley, George Basil, B.S. in M.E.; Sikorsky Aircraft Div., United Aircraft Corp.

Dommasch, Daniel Otto, M.Ae.E.; Aeronautical Engineer, C.A.A.

Eames, James Owen, Ae.E.; Partner and Project Engineer, Roy S. Sanford Engineering Co.

Ewald, Clarence Francis, B.S. in C.E.; Structures Engineer, Lockheed Aircraft Corp.

Giannini, Gabriel Maria, Ph.D.; President, G. M. Giannini & Co., Inc.

Guthrie, Richard Hamilton, B.Sc.; Project Engineer, Engine Design Section, Turbo Research Limited (Canada).

Hartley, Max Elmo, Asst. Group Engineer, Boeing Aircraft Co.

Herreshoff, James Brown, M.A. Physics; Structural Engineer A., El Segundo Div., Douglas Aircraft Co., Inc.

Howland, Daniel, Ensign, U.S.N.R.

Israel, Edmund, B.S. in M.E.; Design Group Engineer, Lockheed Aircraft Corp.

Landis, Merle Anthony, B.Ae.E.; Sr. Aerodynamicist, North American Aviation, Inc.

Layton, James Preston, B.Ae.E.; Lt. Comdr., U.S.N.R.

Lee, Sherman Hawk, B.S. in M.E.; Asst. Project Engineer, Edo Aircraft Corp.

Mariano, Toribio S., B.S. in Ae.E.; P-3 Aero. Engineer, Air Technical Service Command.

Mercer, F. Bruce, B.S. in M.E.; Flight Test Instrumentation Engineer, Boeing Aircraft Co.

Naiman, Jacob, B.S. in Ae.E.; Capt., Flight Test Engineer, U.S. Army Air Forces.

Schoenen, Hermann, M.E.; Preliminary Design Engineer, Boeing Aircraft Co.

Slaughter, Lomis, Jr., B.S. in M.E.; Group Engineer, Boeing Aircraft Co.

Wald, Quentin, B.S. in Ae.E.; Aeronautical Engineer, United Aircraft Corp.

Elected to Industrial Member Grade

Barber, Frederick Arthur, Executive Director, Historical Foundations.

Bourcier, Charles Dolor, Lt. Col., (Chief Sub. Materials & Processing Branch), U.S. Army Air Forces.

Harrison, William Dudley, Pacific Coast Executive, Institute of the Aeronautical Sciences, Inc.

Kimball, Dan Able, V.P. and Mgr., Aerojet Engineering Corp. and General Tire & Rubber Co. of Calif.

Warner, Edward Lothrop, Jr., A.B.; Manager, Aviation Div., Automotive & Aviation Parts Manufacturers, Inc.

Elected to Technical Member Grade

Alfsen, Edgar John, Aircraft Electrical Technical Instructor, Escola Técnica de Aviaçao (Brazil).

Allwardt, Victor Lehnert, B.S. in M.E.; Flight Test Analyst "A," Consolidated Vultee Aircraft Corp.

Banas, Walter, Weights Group Leader, Canadair Ltd. (Canada).

Gwinn, Joseph Marr, III, B.S. in Ae.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

Hill, Joseph James, American Car & Foundry Co.

Huang, Chih-Tsien, B.S. in Ae.E.; Lt., Engineer Trainee, Consolidated Vultee Aircraft Corp.

Montenegro, Carlos Eurico de Breyne, B.Sc.; Asst. Personnel Instructor, Panair do Brasil S/A (Brazil).

Nucci, Louis Mario, B.S. in M.E.; Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Polo, Vincent, Sr. Pilot, U.S. Army Air Forces.

Rector, David Delbrook, Student, Ohio State University.

Reed, John McLellan, B.S. in Ae.E.; Jr. Engineer, Pan American Airways System.

Reuel, Norman Charles, M.S. in Ae.E.; Lt. (j.g.), U.S.N.R.

Schepke, Thomas Leonard, Pvt., U.S. Army Air Forces.

Spitzig, Francis Albert, B.Architecture; Chief of Architectural Div., Design Service Company.

Starr, David Whelpley, Aero Engineer, Bureau of Aeronautics, U.S. Navy Dept.

Stonehouse, Charles Ross, Mechanic and Inspector, R.C.A.F.

Sullivan, James E. P., Laboratory Engineer, Airtemp Div., Chrysler Corp.

Swaim, William Robert, Jr., Ae.E.; Asst. Chief Engineer, Commonwealth Aircraft, Inc.

Thomson, William W., Sgt., U.S. Army Air Forces.

Voyce, Willis Mark.

White, Charles LeRoy, Station Communication Supervisor, Pennsylvania-Central Airlines Corp.

Yoder, Warren George, B.S. in C.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

Transferred from Student to Technical Member

Campbell, Graham Folwell, Jr., B.S. in Ae.E.; U.S. Navy.

Corden, Carlton Donald, B.S. in Ae.E.; Engineering Assistant, Consolidated Vultee Aircraft Corp.

Learned, Don Rankin, U.S. Navy.

Margolin, Louis, B.S.; Ensign, U.S. Navy.

Nietert, Robert William, B.S.; Ensign, U.S. Navy.

Robert, Howard Emery, A.B. in Engineering; Aerodynamics Engineer, Douglas Aircraft Co., Inc.

Stempel, Walter Chapman, B.S. in Ae.E.; Ensign, U.S. Navy.

Telle, George Robert, B.S. in Ae.E.; Ensign, U.S. Navy.

Elected to Affiliate Grade

Lanz, Albert Joseph, Sr. Inspector, Pan American World Airways.

Rinaldi, Leonard Daniel, B.A.Math.; Jr. Aerodynamicist, Curtiss-Wright Corp.

I.A.S.

National Meeting Schedule

1946

AIRCRAFT PROPULSION

March 21–22 — The Cleveland Club, Cleveland, Ohio

LIGHT AIRCRAFT

June 13–14 — Rackham Educational Memorial, Detroit, Mich.

ANNUAL SUMMER MEETING

August — Los Angeles, Calif.

AIR TRANSPORT

October — Hotel Statler, Washington, D.C.

WRIGHT BROTHERS LECTURE

December 17 — New York, N.Y.

Necrology

Harold Alexander Boyce

Harold Alexander Boyce, Vice-President of the Century Precision Works, Inc., and an Industrial Member of the Institute, died on December 12 in Miami, Florida, as the result of a stroke.

Mr. Boyce was born in Astoria, New York, on July 6, 1898, and attended St. Paul's Preparatory School in New York. From 1921 to 1929 he was Sales Manager of the New York Locomobile Company. From 1930 to 1939 he served as General Manager of the Plane Speaker Corporation, a firm engaged in advertising through broadcasting from the air. In 1940 he joined the Bridgeport Brass Company and was in charge of marketing special automatic devices. He operated his own business, known as "Voice of the Sky," in 1941, and assumed the Vice-Presidency of the Century firm in 1942. From 1942 to 1944 he was a Captain in the U.S. Army Air Forces.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Detail and Layout Engineers, Stress Analysts, Aerodynamicists, and Design Engineers—for development work and production engineering work in engineering division. Write for application blank to Chief Administrative Engineer, Boeing Airplane Company, Wichita, Kan.

Chief of Aerodynamics—To assume full responsibility for department of five to eight engineers. Must have a degree in aeronautical engineering with ten years' experience in aircraft work, five years of which must be in aerodynamics. Write for application blank to Chief Administrative Engineer, Boeing Airplane Company, Wichita, Kan.

Design Engineers; Draftsmen—Opportunities now exist for qualified design engineers and draftsmen for work on the new stratocruiser C-97 military transport and other new developments. Here is an opportunity to become associated with one of the world's leaders in aircraft design and production and to participate in the design of the aircraft of tomorrow. Write to the Engineering Department, Boeing Aircraft Company Seattle 14, Wash.

Aerodynamicists and Thermodynamicists—Research minded and with good theoretical background, to engage in research work on high-speed and jet propulsion developments, advanced degrees preferred. Salary commensurate to qualifications. Replies will be held in strict confidence. Write, giving education and experience, to Curtiss-Wright Corporation, Research Laboratory, Buffalo, N.Y.

Aeronautical Engineering Professor to teach Airplane Design, Airplane Structure, and related subjects. Applicants required to have a degree in aeronautical engineering as well as practical experience in the field. Preference given to candidates having advanced degrees. Facilities now under construction and plans for future construction will provide ample opportunity for research, development, and consultation. Rank and salary will depend upon training and experience of applicant. In applying please give brief sketch of personal qualifications, education, and experience. Address reply to Prof. Robert M. Pinkerton, Department of Aeronautical Engineering, A. & M. College of Texas, College Station, Texas.

Aircraft Engineers—Immediate, permanent openings for aircraft engineers with 5 years' experience in aerodynamics, structural design, and C.A.A. airworthiness requirements with Southern California aircraft manufacturer. Air-mail qualifications and recent photo to P.O. Box 29, Burbank, Calif.

Detail and Layout Engineers, Stress Analysts, Aerodynamicists, and Design Engineers—For development work and production engineering work in Engineering Division. Call in person or write to Chief Administrative Engineer, Boeing Airplane Company, Wichita, Kan.

Radio, Electronic and Telephone Engineers, Electronic and Mechanical Draftsmen—One of the largest manufacturers of a wide variety of electronic and communications equipment in the world is fully prepared and ready with an ambitious postwar program. Write to Personnel Manager, Federal Telephone & Radio Corp., 591 Broad Street, Newark, N.J.

Aeronautical Engineer—To teach Senior year subjects of aeronautical engineering course including design and stress analysis. Address inquiries to The Aeronautical University, Inc., 116 South Michigan Avenue, Chicago, Ill.

Aircraft Stress Engineers thoroughly familiar with the analysis of aircraft structures, aircraft controls, and all component parts for work on helicopters. Excellent opportunities for personnel interested in rotary-wing aircraft. Apply by letter, giving references, to Administrative Engineer, Kellett Aircraft Corporation, Plant #2, Lansdowne Avenue above State Road, Upper Darby, Pa.

Personnel Needed—Executive and Administrative experience in manufacture of aircraft. Positions available in several fields: Factory and Production Management, Matériel, Tooling and Engineering. McDonnell Aircraft Corporation, Ambassador Building, St. Louis 1, Mo.

Aeronautical Engineers—for immediate work, the long-established Aeronca Aircraft Corporation seeks project engineers, design engineers, weight engineers, and layout draftsmen. These positions offer unusual permanent opportunities with the pioneer light-plane company of America for qualified men. Write in complete detail to Aeronca Aircraft Corporation, Box 00, Middletown, Ohio.

Chief Stressman with C.A.A. requirements experience, and **One or Two Assistants,** to take charge new project. Permanent position with aircraft manufacturing firm on middle eastern coast. Reply stating full particulars of past experience, salary required, and when free to take up a new position. Address inquiries to Box 462, Institute of the Aeronautical Sciences.

Layout and Detail Draftsmen, Senior and Junior—Required for progressive aircraft program with aircraft manufacturing firm on middle eastern coast. Reply stating full particulars of past experience, salary required, and when free to take up a new position. Address inquiries to Box 461, Institute of the Aeronautical Sciences.

Aircraft Design Engineers—Immediate permanent openings for design engineers with good experience in aerodynamics, structural design and C.A.A. airworthiness requirements with aircraft manufacturing firm on middle eastern coast. Reply stating full particulars of past experience, salary required, and when free to take up a new position. Address inquiries to Box 460, Institute of the Aeronautical Sciences.

Laboratory Technician—Electrical and ignition-laboratory work. Preparation of tests and models. Performance and analysis of tests. Must be familiar with modern radio and electronic circuits and methods, such as cathode-ray techniques. Applicants should have an interest in "metal to glass" sealing methods and the application of metal-bonded ceramics to high-frequency insulating designs. Starting salary of $70 to $85 for 40-hour week; time and one-half for any overtime. Address inquiries to Box 459, Institute of the Aeronautical Sciences.

Designing Draftsman—Design ignition components of electronic and electromechanical nature. Also do follow-up on experimental orders. Should be conversant with design for low-cost production. Starting salary of $70 to $85 for 40-hour week; time and one-half for any overtime. Address inquiries to Box 458, Institute of the Aeronautical Sciences.

Assistant Engineer—Design work, test work, test analysis, and creative development work in high-frequency ignition and electrical test equipment program. Must have experience in modern electronic design, test and development methods. Starting salary of $4,200 to $4,800. Address inquiries to Box 456, Institute of the Aeronautical Sciences.

Aeronautical Engineers—Immediate positions open in Washington, D.C., for aircraft engineers with practical experience in structural design and research. Salary between $3,640–$5,180 per year. In applying please give brief sketch of personal qualifications, education, and experience. Address inquiries to Box 448, Institute of the Aeronautical Sciences.

Stress Analyst—Engineer with experience in design of rotary wing aircraft rotor blades. Must have thorough knowledge of rotor blade stress and aerodynamic analysis procedure, experimental procedure for determination of static and dynamic stresses and fatigue research methods. Permanent position involving study of wood, metal, and plastic blades. Address inquiries to Box 443, Institute of the Aeronautical Sciences.

Assistant Professor of Aeronautical Engineering—Must have experience in structural analysis and design. Permanent position. Applicants should furnish details describing education, experience, and personal data. College located in Virginia. Address inquiries to Box 442, Institute of the Aeronautical Sciences.

Assistant Professor—To conduct senior and graduate courses, develop laboratory, and direct research in aircraft power plants, with emphasis on standard aircraft engines and accessories. Advanced degree preferred. Position with an established aeronautical engineering department of a large eastern university. Appointment September, 1946. Salary open. Address inquiries to Box 434, Institute of the Aeronautical Sciences.

Aircraft Layout Draftsmen—Familiar with layout and design of aircraft sheet metal structures, controls, mechanisms, power plant, electrical systems and equipment. Excellent opportunities for experienced personnel interested in helicopter design. Address inquiries to Box 414, Institute of the Aeronautical Sciences.

Assistant or Associate Professor—To conduct undergraduate and graduate work in theory, design, and research in propellers and jet and rocket propulsion systems. Applicant should have at least one graduate degree and a sound theoretic and applied background in the thermodynamics and aerodynamics of propulsion systems. Large Midwestern University. Address inquiries to Box 413, Institute of the Aeronautical Sciences.

General Manager—A medium-sized aircraft company has opening for man qualified to direct manufacturing, sales, quality, personnel, accounting, and engineering functions. Must have long experience in management and good education. Company working on Government contracts, commercial aircraft production, and other manufacturing. Address inquiries to Box 410, Institute of the Aeronautical Sciences.

Research Fellows—To work half time on industrial research programs and study half time for M.S. or Ph.D. degree. Salary $1080 for 12 months together with freedom from tuition fees. Extra compensation during summer months may be obtained by working full time. Address inquiries to Box 398, Institute of the Aeronautical Sciences.

Research Engineer—To work on industrial research program. Electrical, mechanical, or civil engineering degree and some experience in materials-testing and vibration theory desirable. Salary $2600 or more depending on experience. Address inquiries to Box 397, Institute of the Aeronautical Sciences.

Engineer of Tests—To take charge of commercial and industrial structures and materials tests. M.S. degree and laboratory experience desirable. Opportunity to work for doctorate. Salary $3000 or more for 12 months depending on experience. One month vacation with pay. Address inquiries to Box 396, Institute of the Aeronautical Sciences.

Project Engineer—Experienced and talented design man to undertake the responsibility for a new aircraft project from inception to completion. Plant located on eastern seaboard. Salary scale above average. Write full particulars. Address inquiries to Box 370, Institute of the Aeronautical Sciences.

Works Manager—Manufacturing executive to set up and operate a production program on a new aircraft. Will direct Manufacturing, Facilities, Inspection and Procurement Departments. Salary scale above average. Located on eastern seaboard. Write full particulars. Address inquiries to Box 369, Institute of the Aeronautical Sciences.

Airplane Salesmen—Large established producer of personal aircraft seeking several qualified airplane salesmen with both flying and merchandising experience. Interview in New York. Address inquiries to Box 362, Institute of the Aeronautical Sciences.

Assistant Sales Manager—Large established producer of personal aircraft seeking qualified assistant sales manager. Interview in New York. Salary commensurate with ability. All replies treated confidentially. Address inquiries to Box 361, Institute of the Aeronautical Sciences.

Associate Professor of Aircraft Structures—To teach senior and graduate courses in aircraft structural theory, develop structures laboratory, and direct graduate structural research work. Practical experience necessary. Advanced degrees preferred. Permanent position. Leading State University. Location—Midwest. Address inquiries to Box 340, Institute of the Aeronautical Sciences.

Associate or Full Professor: To teach advanced courses and direct research in the Aircraft Power Plant Design field. Recent experience in turbine and jet engine design and testing necessary. Advanced degrees preferred. Permanent position, large mid-western university. Can wait six months if necessary. Address inquiries to Box 339, Institute of the Aeronautical Sciences.

Assistant or Associate Professor of Aerodynamics—Young man with Ph.D. to teach graduate courses in theoretical aerodynamics and direct theoretical and experimental research in this field. Research experience necessary. Position permanent. Mid-western State University. Address inquiries to Box 338, Institute of the Aeronautical Sciences.

Associate or Professor of Aerodynamics—To teach performance, control, stability and develop correlating flight test and flight instrumentation courses for large mid-western university. Position permanent. Practical experience necessary. Advanced degrees preferred. Address inquiries to Box 337, Institute of the Aeronautical Sciences.

Patent Engineer—Familiar with patent disclosures and procedures. Essential helicopter industry. Salary commensurate with experience and present earning capacity. Address inquiries to Box 322, Institute of the Aeronautical Sciences.

Assistant Professor—To teach Mechanics, Strength of Materials, and

Physics in a small Mid-western College. Must have Master of Science Degree, preferably in Engineering or Physics. Salary dependent on qualifications and experience. Position permanent. Address inquiries to Box 291, Institute of the Aeronautical Sciences.

AVAILABLE

Engineer—E.E.; Executive or Administrative. Thirty-one years old. Ten years' experience electronics, servos, aircraft and industrial controls, ignition, sales engineering. Qualified in automatic temperature and propeller pitch controls and automatic pilots. Previous positions: head of research lab, central office engineer, assistant chief engineer, chief engineer. Capable of directing activities and handling men. Responsible position. Available immediately. Address inquiries to Box 271, Roslyn, L. I., New York.

Engineer—Four years' experience as layout draftsman on wood and aluminum-alloy construction; desires position as project group leader; location in eastern states preferred. Address inquiries to Box 457, Institute of the Aeronautical Sciences.

Planning and Scheduling Engineer—M.E. degree, 1940, Carnegie Institute of Technology (Aero Option). Six years of experience. One year of experience in planning and scheduling the complete airplane before design given to project. Actual job coordinated with a representative from the factory and representative from engineering production design department and himself. Three years of experience in structural design supervision. One year of experience in engineering liaison. Desires position breaking down the design, planning the component parts and scheduling, and following its progress throughout its engineering design stages. Address inquiries to Box 455, Institute of the Aeronautical Sciences.

Management Executive—Vice-president and general manager of engineering for consulting company doing war work seeks new connection. Twenty years' experience as executive in engineering, production, and general management. Specially qualified as an organizer and production consultant. Experienced major air-line executive. Address inquiries to Box 454, Institute of the Aeronautical Sciences.

Executive—Age 37, single, Protestant, English-American. Fifteen years' continuous, well-rounded aircraft experience. Has experience in ground and flight instruction; airport and seaplane base management; airplane sales (sold over 50 aircraft prewar); charter and photographic; airline; manufacturing (inspector to factory manager); C.A.A. (inspector), quality control, engineering, research, and development. Was a key man with prime contractor (airframe) during the war (now reconverting to non-aeronautical product). Has valid commercial pilot, seven ground instructor, A. & E., radio operator, and F.A.I. glider pilot certificates. Familiar with latest metal, plastic bonded wood, and composite aircraft techniques; also conventional, amphibious, and rotating wing aircraft. Desires position where knowledge, experience, initiative, and results are of prime importance. Last salary—$7,000. Address inquiries to Box 453, Institute of the Aeronautical Sciences.

Engineer - Executive - Consultant—B.S. in Aero Eng., B.S. in Business Administration, University of Minnesota. Formerly assistant to factory superintendent, major aircraft company; assistant chief engineer, aircraft parts plant; quality manager, aircraft parts and assembly company. Presently on Staff of Naval Air Operating Command responsible for operation of structures, engines, including turbojet, electronics, ordnance, instruments, photographic, and safety equipment departments. Familiar with design, maintenance, and operation of all combatant, utility, and transport type naval aircraft. Desires permanent position preferably in the Middle West offering executive responsibilities in an administrative consultant or advisory capacity. Will consider any position requiring initiative, responsibility and a combination of business and engineering training and experience. Available after February 15. Address inquiries to Box 452, Institute of the Aeronautical Sciences.

Mechanical Aeronautical Engineer—B.S.M.E. (Aero Option). Twenty-eight years old, six years' experience on propellers and propeller accessories and manufacture of precision parts. Design engineer on helicopter rotors and controls for two years. Some experience in textile machinery. Desires responsible position as design or project engineer in eastern area. Address inquiries to Box 451, Institute of the Aeronautical Sciences.

Pilot—Engineer—World War II veteran with five years' flying experience in the U.S. Marine Corps. B.S. in Mechanical Engineering (Aero Option), Virginia Polytechnic Institute. Holds a valid commercial pilot certificate. Prefers a position involving flying. Will locate anywhere. Address inquiries to Box 450, Institute of the Aeronautical Sciences.

Inspector and Quality Control Engineer—Five years' experience with high-altitude fighter planes, desires employment with an air line. B.S. degree; speaks three foreign languages fluently; any location. Address inquiries to Box 449, Institute of the Aeronautical Sciences.

Aeronautical Engineer—With own design of practical roadable airplane having basically new and desirable features seeks connection with aircraft manufacturer who has well-established manufacturing facilities but needs a product. M.I.T. Graduate with 10 years' sound aircraft engineering experience. Address inquiries to Box 447, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E. Fourteen months' aircraft experience in application and development of new materials and processes, trouble shooting, production testing, specification writing. General design experience (studio). Two articles published in *Aero Digest*. Young, with initiative. Any location. Desires position with development group of production-minded manufacturer. Address inquiries to Box 446, Institute of the Aeronautical Sciences.

Aircraft Design Engineer—Has aeronautical education. Seven years' experience in many phases of aircraft design, including layout drafting, testing, and liaison on aircraft equipment installation. Desires responsible position in engineering or experimental department of small aircraft or aircraft equipment manufacturer, or air line. Willing to travel. Address inquiries to Box 445, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Twenty-two years old. Will graduate March 29, 1946, from aeronautical school. Has lived in Spanish-American country for 16 years. Writes and speaks Spanish and English fluently, thoroughly acquainted with Latin customs. Desires position in which engineering training and knowledge of Spanish and English would be of value, either in the United States or Latin America. Address inquiries to Box 444, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in A.E.; age 32. Experienced in layout, design, stress analysis, and supervision in plywood and all-metal aircraft and helicopters including basic design and simplification of structures. Desires position in Mid-West if possible. Present location, Detroit. Address inquiries to Box 441, Institute of the Aeronautical Sciences.

Mechanical Engineer—M.S.E.; 32 years old; with good background in mathematics, applied mechanics, vibrations. Varied experience in research, development, and testing of mechanical products. Thoroughly familiar with mechanical laboratory methods and equipment. Desires position requiring such knowledge and experience, preferably with research and development organization. Address inquiries to Box 440, Institute of the Aeronautical Sciences.

Engineer—Administrative Liaison—Aeronautical Administrative Engineer—Seven years' air-line operation maintenance experience with international air line and U.S. Naval Air Transport Service. Lieutenant Commander, Squadron and Staff Engineering Officer. B.S. in Mechanical Engineering (Aero Option), Univer-

sity of California. One year, Harvard Business School. Permanent position with international transportation concern desired. Available immediately. Address inquiries to Box 439, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Fourteen years actively engaged in the aircraft industry, including project design, flight test, and development engineering, and as representative in procurement and field service. Thorough knowledge of maintenance and flight operation, including A. and E. licenses and 7 years' flight experience. Present affiliation with major aircraft company, entered in 1937. Desires permanent responsible position and opportunity for advancement, commensurate with ability, in development, sales, or as technical representative. Geographical location unimportant. Four years of university work and graduate of two leading schools of aeronautics. Understands Spanish and French. Excellent commercial and military references. Address inquiries to Box 436, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E., University of Minnesota. One year detail design and minor layout drafting. Over four years' service with Air Technical Service Command, U.S.-A.A.F., as engineering officer. Military experience included one year of checking contractor-submitted stress analyses and the design and supervision of installation, in aircraft, of experimental equipment; three years as resident liaison engineer for A.A.F. at large West Coast aircraft manufacturer. Served three months in England and Germany with Air Technical Intelligence Section of U.S. Strategic Air Forces as technical investigator of German aircraft development. Desires permanent position with opportunity for advancement in technical or administrative engineering or allied field. Los Angeles area preferred. Available now. Address inquiries to Box 435, Institute of the Aeronautical Sciences.

Engineering Draftsman—Four and one-half years' experience in aircraft work, 1 year, sheet metal layout; 6 months, tool design; 2 years, aircraft hydraulics; and 1 year, shop liaison. Three years of college. Desires position in Chicago area with organization offering future. Will consider position in other than aircraft industries, but aircraft industry preferred. Draft exempt. Excellent references available June 1. Address inquiries to Box 433, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Graduate work in Ae.E. Almost 6 years' experience in flight test, stability and control, and wind-tunnel testing on multiengined landplanes and seaplanes with large company. Desires stability and control or flight-test work with West Coast air line. Address inquiries to Box 432, Institute of the Aeronautical Sciences.

Engineer—Manufacturer—Eighteen years in aircraft industry. Experienced as Chief Engineer of large aircraft company during the war. Also experienced in operation of own company manufacturing subcontract aircraft parts. Desires position with small company having proprietary articles to engineer, manufacture, and sell. Have private pilots' license and fly own light airplane. Address inquiries to Box 431, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Officer R.C.A.F. Engineering education. Six years' aircraft maintenance, liaison inspection and engineering in manufacture and overhaul of military aircraft. Considerable technical administration work. Glider construction and design experience. Desires position whereby technical qualifications can be utilized and experience to a more advanced standing possible. Future opportunity is the prime requisite. Address inquiries to Box 430, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Five and one-half years' experience in Airline Engineering (Operation and Maintenance) and Aircraft Manufacturing. Two degrees in Aeronautical Engineering. Part time work desired. Address inquiries to Box 429, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E. Two and one-half years' experience with a leading aircraft manufacturer as layout draftsman and preliminary stress analyst. Served with Marine Corps Aviation as Commanding Officer of service squadrons, Group Engineering Officer, at present Production Superintendent of overhaul activity. Nearly five years of active duty in U.S. and overseas. Desires to become connected with engineering staff or air line for maintenance, overhaul work, or allied subjects. Address inquiries to Box 428, Institute of the Aeronautical Sciences.

Engineer—World War II veteran, engineering degree. Eight years' flying experience in U.S. Navy, 4 years service engineering, 2 years test-pilot and development work. Qualified in various types service planes including single and multiengine, both land and sea. Recent experience in jet-propelled aircraft. Desires opportunity to do research and development work including flying. No objection to traveling. Excellent references. Address inquiries to Box 427, Institute of the Aeronautical Sciences.

Air Passenger Research—College graduate, experienced. Available temporary or permanent. Address inquiries to Box 426, Institute of the Aeronautical Sciences.

Chief Engineer, Mechanical, Development and Research—Wide experience, automotive and aeronautical, ball and roller bearings and all applications, gears, landing gear; initiated current propeller; mature judgment, capacity for detail, executive experience. Ability to analyze new design, foresee possibilities, and carry from start to production drawings. Now have paying consulting business but prefer direct responsibility. Address inquiries to Box 425, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in General Engineering from Georgia Tech. 24 years of age. Three years' experience in dynamic stability research; duties included design of wind-tunnel models and some maintenance and wind-tunnel operation. The last 6 months have been spent in development and flight tests of rocket-propelled missiles. Desires position as aerodynamicist or flight test engineer, preferably on development of new design. Excellent references. Address inquiries to Box 424, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Graduate with eighteen years of practical experience in aircraft design and engineering with emphasis on aerodynamics, wind-tunnel testing, flight-testing, power plants and weights control. Desires a supervisory position in connection with aircraft design and development engineering or flight test. Address inquiries to Box 423, Institute of the Aeronautical Sciences.

Aeronautical Engineers—Recently incorporated organization of experienced engineers is interested in designing a complete airplane or any of its parts. Aerodynamic, structural, and power-plant installation problems capably executed. Complete responsibility will be assumed for obtaining C.A.A. approval. The diversified background of our engineering staff in designing for production assures a product which not only incorporates sound engineering, but also can be manufactured economically. Address inquiries to Box 422, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.Ae.E. degree. Five and one-half years' experience in stress analysis and design of large aircraft structures with a large eastern concern. Familiar with all parts of the airplane. Part time spent as group leader. Mid-West location preferred. Would like airline work. Address inquiries to Box 421, Institute of the Aeronautical Sciences.

Engineer—One and one-half years' experience as structural test engineer and stress analyst with major aircraft company. M.E. graduate of Lowell Institute School, M.I.T. No objection to traveling. Address inquiries to Box 420, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in Ae.E. with approximately 12 years'

experience in military and civil airplane engineering. Complete structural responsibility on recent Navy and Army fighter airplanes with large organization. Inventive ability and productive minded. Knowledge of loads, vibrations, and flight testing. Experienced in supervising large group. Desires a permanent and responsible design or stress position in progressive organization in East or Middle West where his experience and abilities can be fully utilized. Address inquiries to Box 419, Institute of the Aeronautical Sciences.

Aeronautical Engineer, Executive—B.Ae.E., age 33, Commander U.S.N.R., available shortly. Seven years' experience in design, development, modification, overhaul and maintenance of naval aircraft, both production and experimental types. Particularly strong on structures. Administrative experience. Desires responsible position where initiative and capabilities can be employed. No objection to traveling. Willing to locate anywhere. Will consider affiliation with progressive nonaircraft organization. Address inquiries to Box 418, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Bachelor's and Master's degrees in aeronautical engineering. Eight years' experience with Army, Navy, and commercial types covering all existing types of construction. Experienced in aerodynamics, structures, basic and detail design, and development and experimental work. Good knowledge of shop practices and thoroughly familiar with C.A.A. design requirements, including new CAR 03. Prefers work on small and medium-sized commercial aircraft. Any location considered. Address inquiries to Box 417, Institute of the Aeronautical Sciences.

Aeronautical Management Engineer—Registered professional aeronautical engineer with over 18 years' broad supervisory experience in aircraft engineering and production. Organization, Methods and Procedures, and Maintenance. Five years as Mechanical and Electrical Engineer. Will set up or improve organization, administrative and other control procedures, production and inspection methods and procedures, production and maintenance design; cut manufacturing, operating, and maintenance costs, initiate and maintain liaison with Government and industry for Air Line or Aircraft Manufacturer. Recently Chief, Maintenance Control and Chief, Methods and Procedures, for 2 years with U.S. Army Strategic Air Forces and Air Technical Service Command. Address inquiries to Box 416, Institute of the Aeronautical Sciences.

Executive Engineer—Graduate engineer with eight years' aircraft experience including production planning, cost estimating, master scheduling, and past five years senior design engineer. Prefers Mid-West location in aircraft or allied field. Address inquiries to Box 415, Institute of the Aeronautical Sciences.

Manufacturing Executive—Twenty years' experience, mostly aircraft, all phases manufacturing and procurement. Specialized in planning, material control, estimating, production control, procurement and production management. Available immediately. Address inquiries to Box 412, Institute of the Aeronautical Sciences.

Engineer—Wing structures specialist. Ten years' experience, seven in structural design, three in stress (including fuselage bending analysis as well as wing). In charge of structure for thin airfoil design nearing completion. Anxious to do more work in thin airfoils and assume more responsibility. Address inquiries to Box 411, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S.Ae.E., and C.A.A. Aircraft Mechanic Certificate. Experience consists of seven months in aircraft manufacture while attending college, and two years, since graduating from college, in maintenance and design engineering on four-engined transports for commercial airline. Interested in position with another air line, manufacturer's field service technical representative, or similar work. Any location considered. Address inquiries to Box 406, Institute of the Aeronautical Sciences.

Aeronautical Engineer (native Russian)—Would like to translate Russian scientific and technical papers. Thoroughly acquainted with the field of theoretical and applied aerodynamics. Address inquiries to Box 405, Institute of the Aeronautical Sciences.

Aeronautical and Mechanical Engineer—B.S., S.M. Broad experience in theoretical and experimental stress analysis, vibration theory, and instrumentation. Project organization and customer liaison work. Long residence in the Orient. Speaks and writes Russian fluently; some French and Chinese. Interested in responsible position with consulting firm or similar organization having foreign contacts. Address inquiries to Box 404, Institute of the Aeronautical Sciences.

Aeronautical Engineer—M.S. in Ae. and Me.E., 1924. Research, Preliminary design, Development. Past experience includes: Consulting Engineering (research, coordination of new developments); Project Engineer, Aerodynamicist, Research Engineer. High references. Prefers location in United States or Canada. Address inquiries to Box 402, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.A.E. One and one-half years' aeronautical research experience; plus 3 years' experience in structures, drafting, liaison, production expediting for large aircraft corporation. Desires design or production management position with aircraft manufacturer. Address inquiries to Box 401, Institute of the Aeronautical Sciences.

Development Engineer—Aeronautical engineering degree, industrial management training. Five years' experience in aircraft engine design and research aircraft production, editing. Ideal assistant for busy executive. Will conduct correspondence and technical writing, assist in project administration, planning and coordination, or handle strictly technical assignment. Address inquiries to Box 400, Institute of the Aeronautical Sciences.

Hydraulic Service Engineer—One year at Purdue University; one year at Indiana University Extension. Graduated from Aviation Mechanical School, Curtiss-Wright Tech., Glendale, Calif., with high scholastic honors. Approximately six years' experience in aircraft hydraulics as teacher, designer, mechanic, and school supervisor. Taught and supervised aircraft hydraulics at Curtiss-Wright Tech. Established, taught, and supervised aircraft hydraulics at Utah State College at Logan, Utah. During the past 3 years, while in the Navy, has been assigned to duty as hydraulic supervisor and established one of the largest aircraft hydraulic schools in the country. During these 3 years has also designed and constructed hydraulic valves, fittings, test benches, and mock-ups for Navy use. Possesses a C.A.A. airplane mechanic certificate. Mechanical background: welder, lathe operator, riveter, etc. Address inquiries to Box 399, Institute of the Aeronautical Sciences.

Test Pilot—B.S. in A.E., Oregon State College. Five years of Navy flying, including Instructor in single and multiengine aircraft: 1,000 hours four-engine time; 1,000 hours twin-engine time; 2,800 hours total. Thirteen months of Aleutian flying, Navy Maintenance Officer, Weight and Balance. Holds commercial, instrument, and radio licenses. Desires engineering test with foreign or domestic company. Address inquiries to Box 395, Institute of the Aeronautical Sciences.

Mechanical-Aeronautical Engineer—B.S. in M.E., University of Michigan. Seventeen years' experience with aircraft manufacturers, air lines, and aircraft maintenance equipment manufacturer. Designed and patented manufacturing and maintenance equipment now used extensively in the industry. Held responsible positions in development, design, sales and management. Broad general experience in most phases of the aeronautical industry throughout the United States. Desires executive position with an air line or allied industry manufacturing aircraft, aircraft equipment, or maintenance equipment for the air lines. At present is a naval officer on air-transport engineering duty. Expects to be released to inactive duty in January, 1946. Address inquiries to Box 394, Institute of the Aeronautical Sciences.

(Continued on page 37)

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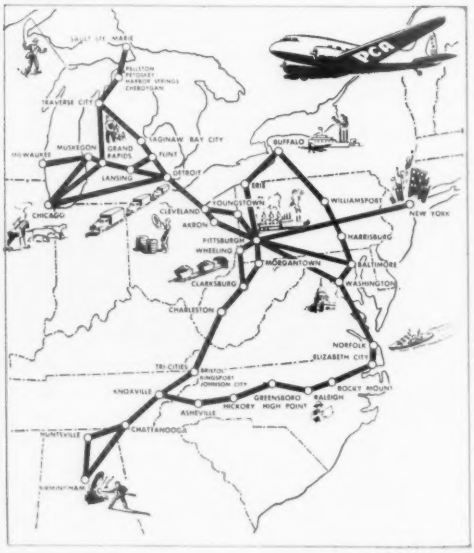

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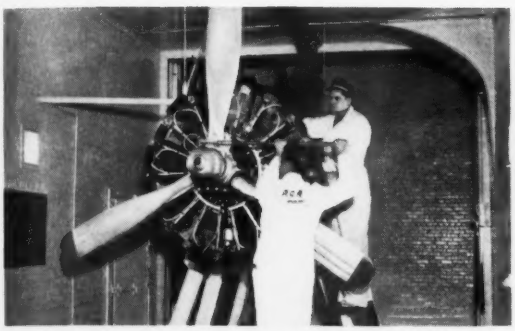
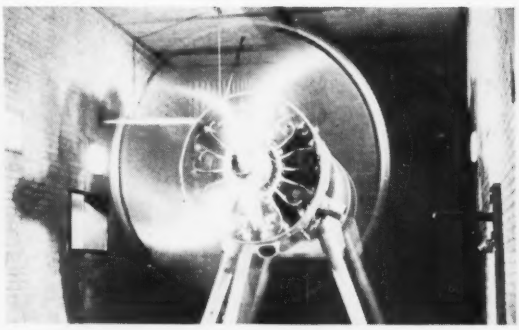
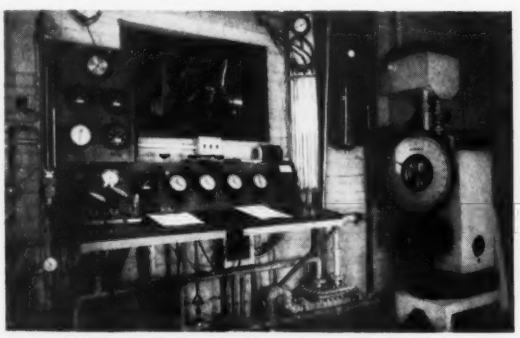


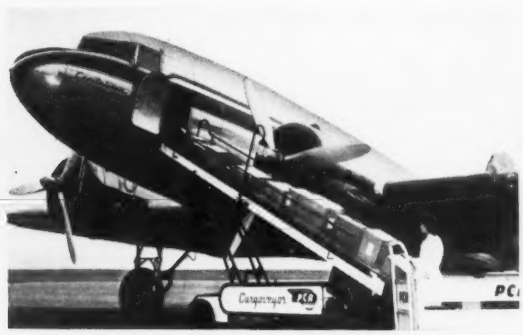
THE DYNAMIC ENGINE MOUNT developed by PCA tuning up for test cell run.



TEST under way during overhaul saves 16 man-hours per engine.

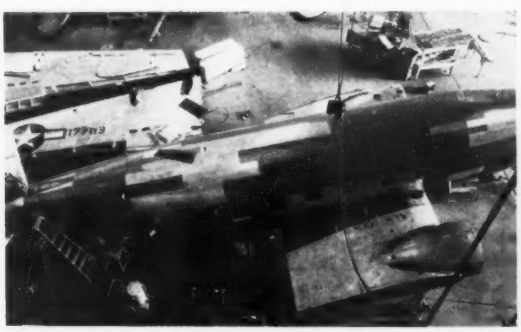


PCA TEST ENGINEERS keep meticulous records at this master control board.



THE CARGOVEYOR, electrically driven leveling device, was devised by PCA engineers.

PCA DESIGNED first cargo-type airplane with detachable fuselage.



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Project Engineer—B.S. in M.E., Aero. E. Thirty-five years old. Over 10 years of aircraft design, structural layout and administrative duties. Seven and one-half years of supervisory experience in engineering, seeking executive or supervisory position, not necessarily in aviation. Location open. Address inquiries to Box 392, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. Aero. Eng., New York University, 30 years old, married. Eight years' experience in design and design supervision as Group Leader and Assistant Project Engineer for various prime contractors of military aircraft. Complete and varied experience in all phases of aircraft design, including structural, power-plant installation, controls, armament, equipment, hydraulics, etc. Also shop experience, engineering shop contact, flight-test, and general administrative experience. Responsible position in any field considered. Location on East Coast preferred, but not essential. Address inquiries to Box 391, Institute of the Aeronautical Sciences.

Design Engineer—Available on fixed basis for specific designs of aeronautical, structural or mechanical nature. For detail qualifications address inquiries to Box 390, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Pilot—Graduate Aeronautical Engineer with 2½ years in Army Air Forces, including "Aircraft Maintenance Engineering" course at Yale University and A.A.F. pilot training. C.A.A. Commercial Pilot and Ground Instructor. Desires position with flying school or engineering division of air line. Willing to work in foreign country. Address inquiries to Box 389, Institute of the Aeronautical Sciences.

Aerodynamicist and Physicist—B.S. in E.E.; M.S. in Applied Physics; 1½ years' Doctorate work in Applied Science. Seven years' teaching experience in university—Aerodynamics, Physics, Fluid Mechanics, and allied subjects including graduate level. Five years' experience as Aerodynamicist, Propeller Designer, and Stress Analyst. Prefers university position with research and consulting possibilities and a possibility of completing Doctorate, or responsible industrial position with good chances for advancement within commuting distance from approved graduate engineering or science college. Address inquiries to Box 388, Institute of the Aeronautical Sciences.

Technical Administration or Technical Sales—Over 20 years of aircraft experience which has covered airplane project design followed by ten years of technical administration work in the top management of two large airplane companies. Wishes responsible position in connection with technical sales. Address inquiries to Box 387, Institute of the Aeronautical Sciences.

Engineer-Executive—Twelve years' experience includes airplane design, stress analysis, and structures. Director of Aeronautical Engineering and Sales in aircraft accessories field. Wide acquaintance in the industry, including manufacturers, air lines, aircraft distributors, A.A.F., and Navy Bureau of Aeronautics. University graduate and professional aeronautical engineer. Seeks permanent connection as a key personnel in design, executive, or sales engineering, or as manager in the aviation department or technical adviser in nonaviation industry. Development and experimental work welcome. Address inquiries to Box 386, Institute of the Aeronautical Sciences.

Administrative Engineer—Graduate engineer with over 15 years' experience in design, research, and manufacturing. Eight years' experience in the administration of a division of engineering of a well known aircraft company. Desires a position of responsibility with a medium sized company that has good prospects for future advancement. Address inquiries to Box 385, Institute of the Aeronautical Sciences.

Engineer—B.S. in Aeronautical Engineering, licensed airplane mechanic, four years' experience. One year on aircraft design and development. Three years as research engineer on aircraft and other types of internal combustion engines. Chinese with good knowledge of language. Desires a responsible position in China in engineering, engineering sales, or as a technical representative in the aviation, oil, or automotive industry. Excellent references. Address inquiries to Box 384, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in Ae.E. (Mexican Citizen); speaks and writes Spanish. Desires position with a small company with good opportunities for advancement. Any location in the United States would be considered. Would also consider a position in Mexico as a representative of a company with business relations in this country. Address inquiries to Box 383, Institute of the Aeronautical Sciences.

Structures Engineer—B.S. in Aero. Engineering. Five and one-half years' stress experience with the Development Engineering Department of a large Aircraft Corp. Desires responsible position in the Los Angeles area. Address inquiries to Box 382, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Ae.E. Two years' experience as Foreman in Charge of Spinning Aircraft Fabrics, two years in Hydraulics and Contact Work, three and one-half years as Design Engineer in Aircraft Turret Work, including Design and Layout Work in Armament. Desires position as Sales Engineer or Project Development work. West Coast or Midwest location preferred. Will accept work in Foreign Country. No objection to traveling. Available immediately. Address inquiries to Box 381, Institute of the Aeronautical Sciences.

Aeronautical Engineer—with own design of helicopter having two coaxially counterrotating lift rotors seeks connection with Aircraft Manufacturer. Thirty years' total professional experience including 15 years' airplane, and 2 years' helicopter design and development. Address inquiries to Box 380, Institute of the Aeronautical Sciences.

Quality Control Manager, Chief Inspector—Eighteen years' aircraft experience. Excellent references. Army or Navy work preferred. Location East Coast. Address inquiries to Box 378, Institute of the Aeronautical Sciences.

Mechanical and Aeronautical Engineer—B.S. in M.E., Aeronautical Engineering Option, 1936. Candidate for M.S. degree in Mechanical Engineering with graduate work to be completed during first year after release from active duty. Two years' experience Machine Tool Design and Drafting; three and one-half years' experience in Aircraft Propeller Design and Vibration Research; one-half year experience in Aeronautical Research; thirty-nine months' service as officer in Army Air Forces Air Technical Service Command's Engineering Division Laboratories and Central District as Project Officer. Highest references. Location near New York City preferred. Address inquiries to Box 376, Institute of the Aeronautical Sciences.

Development Engineer—Graduate Engineer, B.S. in Ae.E., with 6½ years of aircraft and machine design experience, including design of and fabrication contact for varied mechanisms, landing gears, and hydraulic units. Location in Eastern district preferred. Particularly interested in smaller company with expanding postwar plans, in which advancement is possible along with the company. Address inquiries to Box 375, Institute of the Aeronautical Sciences.

Stress Analyst, Design and Development Engineer—B.S. in aeronautical engineering; five years' experience in aeronautical engineering after graduation. Structural design and analysis experience with large manufacturer of military landplanes and seaplanes. More than two years' work in the investigation and development of new structural materials and types of construction including magnesium, plastics, sandwich construction. Experience in latest structural test methods; one-

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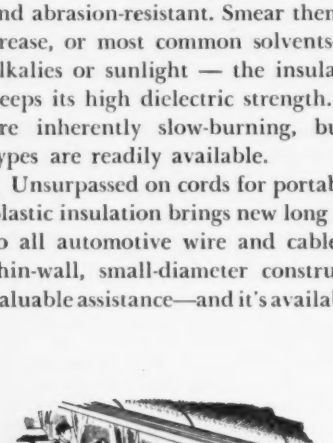

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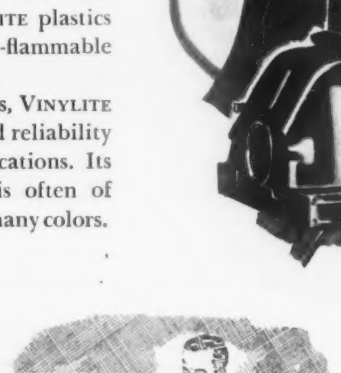

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Engineer, Development or Chief—Over 25 years on airplane design, accessories development, operations engineering, technical writing, and executive work. Wide experience with all types of materials; inventive and possessing initiative. Recent salary $7,500, but will consider proposition. Eastern part of U.S. preferred but not essential. Address inquiries to Box 372, Institute of the Aeronautical Sciences.

Director of Flight Training—Ranking Naval Officer available soon, desires position as Director of Flight Training Program for progressive University. Ten years' teaching, 24 years' aviation. Mechanics, Flight, and Ground Instructor ratings. Organization and operating experience. Address inquiries to Box 368, Institute of the Aeronautical Sciences.

Air-Line Service Engineer—B.S. in Aero. Eng. Over five years with major air line specializing in service problems on some trainers and most types of air transport aircraft. Experienced in troubleshooting, establishing service procedures, etc. Has supervised engineering projects. Desires similar position with small air line or aircraft manufacturer. Address inquiries to Box 367, Institute of the Aeronautical Sciences.

Aeronautical and Structural Engineers—Recently formed engineering organization is interested in contacting aircraft manufacturers in southern California for engineering of entire airplanes or major components. Will assume full responsibility for stress analyses and C.A.A. negotiations. All members of this group have held responsible aeronautical engineering positions in both small and large companies during the last 10 years. Address inquiries to Box 366, Institute of the Aeronautical Sciences.

Gear Expert and Mechanical Engineer—Also has considerable aeronautical experience. Fine leadership qualities coupled with analytical mind. M.I.T. graduate. Age 31. Desires responsible position with consulting firm or other organization. Address inquiries to Box 365, Institute of the Aeronautical Sciences.

Administrative Engineer—B.S. in A.E. from University of Michigan. Graduate of Civilian Pilot Training and possesses civilian pilot's license. Also holds an Aircraft Mechanic Certificate. Graduate of an accelerated course in Maintenance Engineering at Yale University. At present Administrative Officer assigned to an Aircraft Maintenance Unit, A.A.F. Would prefer employment by a commercial air line. Will be available within the next four months. Address inquiries to Box 364, Institute of the Aeronautical Sciences.

Engineer—Aeronautical graduate. Air transportation major. Wishes to apply extensive air-line background of design, performance economics, administration, and publications to a sales or administrative position. Address inquiries to Box 363, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Ten years' experience teaching aeronautics and allied subjects. At present employed by Navy Department in aerodynamic analyses of military aircraft, including considerable work in jet propelled types. Desires a teaching position in the south or southwest by winter or spring term. Address inquiries to Box 358, Institute of the Aeronautical Sciences.

Engineering Service and Sales Representative—Engineering Degree, total of 10 years' aircraft design, accessory and sales engineering, hydraulic and control equipment experience. Extensive contacts, services, aircraft plants, industrial and marine field. Seeking position in engineering or engineering sales or as technical representative in aviation or allied field. Address inquiries to Box 357, Institute of the Aeronautical Sciences.

Aeronautical Equipment and Sales Engineer—Graduate engineer with 14 years' experience in civil and military aviation specializing in the sales and service of aircraft instruments and equipment. Recently released from active service in the Army Air Forces after 6 years devoted largely to pilot training and aircraft and equipment testing. Over 5,000 hours as pilot in military and civil aircraft. Interested in position offering executive responsibilities in the interest of sales and service within this country or abroad. Will consider any position where a broad background in aviation development, initiative, responsibility can be employed. Available for immediate employment. Excellent references. Address inquiries to Box 356, Institute of the Aeronautical Sciences.

Industrial Engineer—B.S.M.E. Eleven years' experience in selecting equipment and supervising installations for aircraft manufacturing processes, including experience in production of airplane motors; also twenty-five years' experience in the automotive engineering and production field. In a position to do consulting work as industrial engineer. Address inquiries to Box 353, Institute of the Aeronautical Sciences.

Engineer—B.S. in M.E. Age 27, married, two dependents. Seven years' varied aircraft engine experience. Past positions include Test Engineer, Supervisor of Carburetor Test Laboratory, and Assistant Chief Inspector. Desires engineering position doing experimental research or product development. East Coast preferred. No objection to traveling. Address inquiries to Box 350, Institute of the Aeronautical Sciences.

Development Engineer, A.E. graduate. Experience includes complete development and sales engineering of aeronautical and mechanical accessories and instruments. Background of light plane and military aircraft design. Private pilot. West Coast location preferred. Address inquiries to Box 349, Institute of the Aeronautical Sciences.

Tool and Gage Foreman—Past 5 years in designing, planning, and supervising gage manufacture. Experience covers other types of precision tools such as broaches, dies, etc. Previous experience in tool and die work outside of aircraft industry. Thoroughly versed in Tool Steel Heat Treating, Nitrioning Process, Stabilizing, Immersion type and Open Hearth Furnaces. Connected with large aircraft manufacturing plant. Seeking position as Foreman or Assistant Foreman with reliable firm, not necessarily aircraft. Willing to locate anywhere in United States and Possessions. Address inquiries to Box 346, Institute of the Aeronautical Sciences.

Registered Professional Aeronautical Engineer—Has successful consulting practice; would like to represent a responsible aviation corporation or air-line company in the Detroit and lower Michigan area. Graduate degrees from two universities; 8 years' experience as consultant, engineer, executive and professional man. Services could cover all fields such as engineering and sales contacts, technical and professional representative, etc. Permanent appointment with modest monthly retainer fee desired. Address inquiries to Box 345, Institute of the Aeronautical Sciences.

Senior Aerodynamicist—Over 20 years' experience in aeronautics. Excellent theoretical background. Now Research Engineer with big company. Desires permanent responsible position, preferably as Consulting or Research Engineer. Address inquiries to Box 344, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S.M.E., University of Colorado; M.S. Aero. Eng., Massachusetts Institute of Technology. Five years' experience: 4 years with A.T.S.C., Engineering Division, Wright Field in Flutter, Aircraft Dynamic Load Measurement, and general development of mechanical and electronic instruments and recording equipment. Desires position in instrument research and development and flight test engineering. Address inquiries to Box 342, Institute of the Aeronautical Sciences.

Helicopter Chief of Structures—Two years' Chief of Structures, Sikorsky Aircraft, formerly Chief Stress Analyst other leading rotowing manufacturer. Licensed professional engineer, New York, New Jersey, Connecticut, Pennsylvania. Twenty years'

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structural designing background. Address inquiries to Box 341, Institute of the Aeronautical Sciences.

Engineer—B.Ae.E.; M.S. in M.E.; Ph.D.; Aeronautics major. Holds pilot's license and C.A.A. ratings to teach all phases of ground school. Prefers position in industry but will consider a university position with research and consulting possibilities. Location on west coast preferred but not a limitation. Address inquiries to Box 336, Institute of the Aeronautical Sciences.

Graduate Aeronautical Engineer—Bachelor and Master of Aeronautical Engineering degrees from N.Y.U. Two and one-half years' engineering in aircraft manufacturing and 2½ years' engineering in air-line maintenance and operation. Recently completed engineering and economic studies on major postwar aircraft for air-line operation. Will receive Masters in Commerce and Finance in 2 years. Draft exempt and release available. Excellent references. Address inquiries to Box 332, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Pilot—Graduate engineer over 15 years' experience in design, research, and manufacturing; eight years as experimental test pilot; eighteen years' flying experience. Past employment includes several years as consulting engineer and chief engineer with large company. No objection to traveling. Address inquiries to Box 307, Institute of the Aeronautical Sciences.

Production Executive—Mechanical engineer with five years' administrative experience in all phases of aircraft construction including line assembly methods, tool and jig design, and one year as Director of Experimental. Served ten years as Works Manager of large plant fabricating precision metal parts for automatic actuating mechanisms. Thoroughly familiar with modern precision machine shop practice, serving eight years as Plant Manager. Manufacturing experience totals 26 years. Automotive background. Enjoys a wide acquaintance among subcontractors in central and eastern area. Will travel. Address inquiries to Box 292, Institute of the Aeronautical Sciences.

I.A.S. Meeting Preprints

A limited number of copies of preprints of papers presented at meetings of the Institute are available for distribution, at a charge of 25 cents each to members of the Institute, and 50 cents to nonmembers, to cover handling and mailing charges. The following lists preprints available from the past three national meetings of the Institute.

SUMMER ANNUAL MEETING

Los Angeles, Calif. **August 16–17, 1945**

Aero-Medical Aspects of Cabin Pressurization for Military and Commercial Aircraft—Col. W. Randolph Lovelace, II, and Lt. Col. A. P. Gagge, Aero Medical Laboratory, Engineering Division, Air Technical Service Command, Wright Field. 11 pages; 5 illus.

*Armament for Jet-Propelled Bombardment Airplanes—R. A. Averitt, Armament Section, Aviation Division, General Electric Company. 11 pages; 4 illus.

†Glass Laminates and Their Application to Aircraft Structures—Capt. George B. Rheinfrank, Jr., and Capt. Wayne A. Norman, Engineering Division, Air Technical Service Command, Wright Field. 17 pages; no illus.

Icing Problems and the Thermal Anti-Icing System—F. L. Boeke and R. A. Paselk, Heating and Ventilating Engineers, North American Aviation, Inc. 45 pages; 19 illus.

‡Research and the Army Air Forces—Brig. Gen. L. C. Craigie, Chief, Engineering Division, Air Technical Service Command, Wright Field. 4 pages; no illus.

*Structural Design Problems in the B-29 Airplane—George Snyder, Chief of Structural Design, Boeing Aircraft Company. 9 pages; 7 illus.

LIGHT AIRCRAFT MEETING

Detroit, Mich. **October 4–5, 1945**

Compatibility of Roadability and Landing Requirements in Aircraft Undercarriages—Reinhardt M. Rosenberg, Design Specialist, Nashville Division, Consolidated Vultee Aircraft Corporation. 25 pages; 5 illus.

Control Operation of Spratt Wing—George G. Spratt, Nashville Division, Consolidated Vultee Aircraft Corporation. 11 pages; 9 illus.

NATIONAL AIR TRANSPORT MEETING

Washington, D.C. **October 25, 1945**

Flying Boats—Capt. C. H. Schildhauer, U.S.N.R., Naval Air Transport Service Command. 9 pages; no illus.

Problems in Transatlantic Air Transport—W. M. Masland, Captain, Pan American Airways System. 10 pages; 4 illus.

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* Published in this issue of the *Aeronautical Engineering Review*.

† Published in the January, 1946, issue of the *Aeronautical Engineering Review*.

‡ Published in the October, 1945, issue of the *Aeronautical Engineering Review*.

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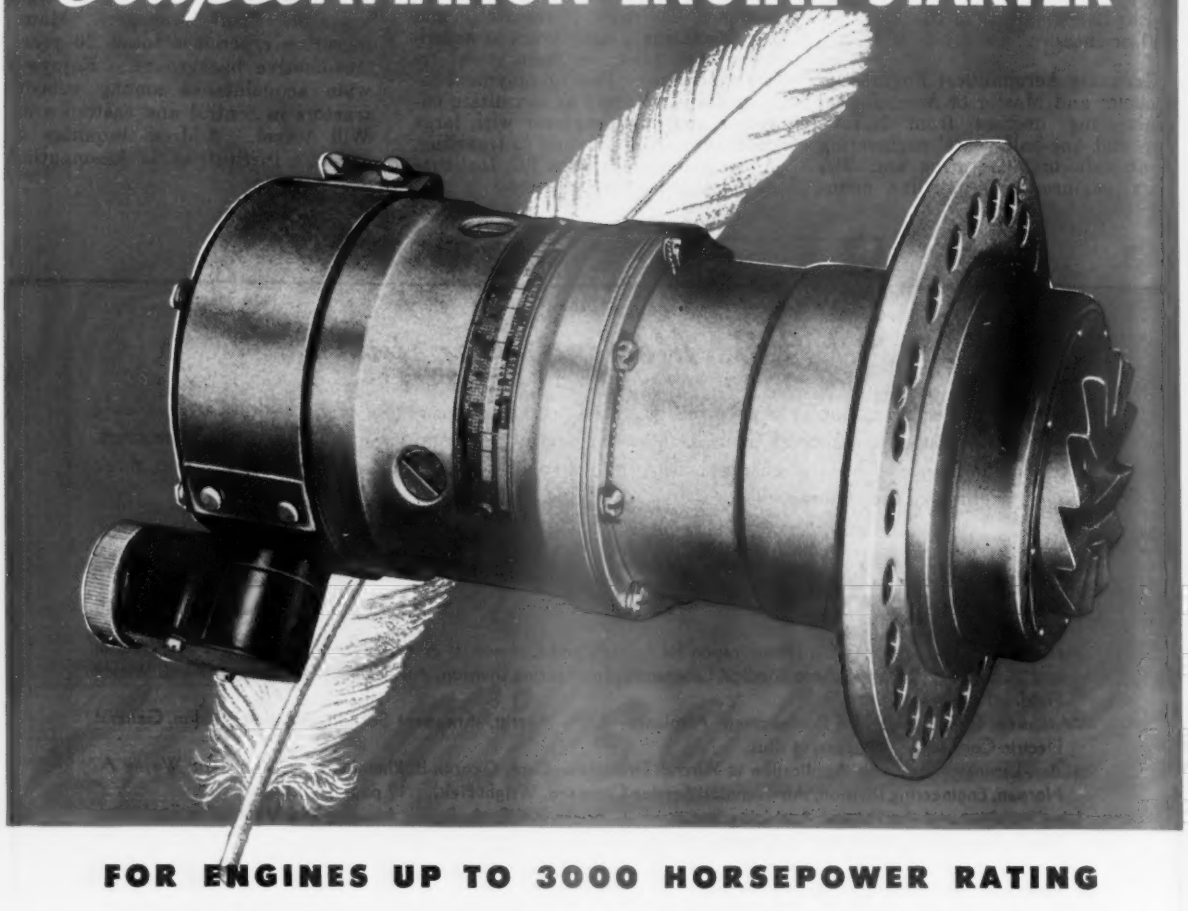

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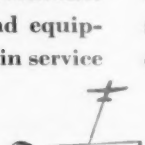

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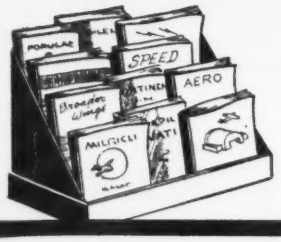

Periodicals

Aerodynamics

Adiabatic Air Flow. G. B. Saksena. It is noted that in most aerodynamic problems it is sufficiently accurate to assume that air is an incompressible fluid, but in the case of high-speed aircraft, such as fighters, the assumption involves considerable error. To make allowance for the suddenness of the change, it would be necessary to discard the notion of the incompressibility of air and to use the adiabatic law between the pressure and the density of air. Thus, a better and truer picture of the actual state of affairs would be obtained by assuming the air to be compressible and investigating the effect on the pressure, density, and temperature of the air. The writer makes a theoretic investigation of the problem on these lines and sets forth the results in the form of tables, graphs, and nomograms that can be easily applied in the solution of any practical problem on flow changes. *Aircraft Engineering*, November, 1945, pages 317–323, 6 illus.

Airfoil Development and Structure Within the Cambered Surface. Part II. Roy A. Liming. The second section of a continued article outlines the objectives of a complete system of standardized analytic calculation techniques. This system includes not only analytic conic controls of streamline bodies such as the fuselage, nacelles, and enclosure shapes, but is also extended to airfoil developments and to basic structural patterns within the cambered surface of the entire airplane. As a preliminary example of the application of analytic geometry to the solution of typical problem patterns involving the space relations of points, lines, and planes, an analytic description is given of the master lines of a typical wing lofted about a reference plane established to compensate for variable incidence. The generalized discussion is presented in order to indicate the proper approach to the analysis of basic-line elements in the cambered surface and internal structure of the airfoil. The next step is to summarize in chart form the essential features of this analytic description as they appear in the treatment of a sample wing development. It is shown that the designer is able to rely exclusively upon the direction-number concept of analytic geometry to define completely the master dimensional specification of a typical wing.

The direction numbers and their use are explained and tabulated, and equations are given by means of which normal intermediate wing sections or stations may be calculated. The direction-number concept is applied to a special wing-lofting factor designated as the direction tangent of a basic percentage line, and instructions are given for calculating the direction tangent. In order to convert from conventional projection-plane views to a true view of the line element, the writer establishes a convenient factor for converting distance measured along any one of the three conventional reference axes to true length along the line. The factor is defined as the direction secant and it is applied to the computation of the true length of the line. *Aero Digest*, December 1, 1945, pages 64–66, 129, 4 illus.

High-Lift Devices and Tailless Aeroplanes. A. R. Weyl. The writer provides some further information about high-lift devices, the discussion of which was started in the previous article of the series. Consideration is given to assisted high-lift devices that are based on the removal or the addition of air from the flow over the wings. Devices based on the suction method, discharge method, and combined suction and discharge method are reviewed. Rotors, rotor wings, and other possible high-lift devices are examined. The results of the study are summarized. *Aircraft Engineering*, November, 1945, pages 325–328, 330, 7 illus.

Nekotorye Osobennosti Komponovki Radiatorov v Kryle Samoleta (Some Particulars of the Airplane Wing Radiator Group). IU. G. Limonad. Full-scale tests were made on a trapezoidal wing with radiator openings in the leading edge, in order to determine the causes of interference between the duct and the wing and to ascertain the aperture shape causing the least interference. Reduction in lift attributable to placing the entrance apertures too near the upper surface of the wing, and duct losses, were lessened by lowering the entrance aperture and reducing its width. Improved performance and a saving in weight were obtained by redesigning the duct exits. The preservation of the flow around the wing surfaces was shown to be one of the most important factors in the design of wing radiators. *Tekhnika Vozdushnogo Flota*, February, 1945, pages 13–15, 4 illus.

Mathematical Theory of Gas Flow. Part I. Max M. Munk. In the beginning section of a serial article the writer lays the formal mathematical foundation necessary to an understanding of the origin and nature of the variables employed in the mathe-

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matical theory of gas flow, their mutual relationship, and their organization into sets. He explains the assumptions relating to the variables of motion and the equations between them, showing why it is desirable to abandon the space coordinates and to adopt instead the velocity coordinates as the independent variables. By means of Legendre's rule of transformation and other calculations, values are established for the density, velocity, and other properties of a hypothetic gas, with a step-by-step explanation of the development of a series of 22 equations. These equations will be employed in a subsequent installment in which the significance, meaning, and application of the mathematical relations will be discussed. *Aero Digest*, December 1, 1945, pages 49, 164, 167.

Air Cargo

Today It's Air Freight. Particulars are given about the organization and operations of the National Skyway Freight Corporation, which is conducted by former members of the American Volunteer Group. Information is included about the executive personnel, equipment, service, charges, and financial backing of the company. *Skyways*, January, 1946, pages 24, 25, 68, 5 illus.

Air Power

Summation—with Aviation to Victory. A summary of the contributions made to victory by Canada's wartime aircraft industry and the British Commonwealth Air Training Plan. Tabulations list the production records established during the years 1939–1945 by the assemblers of the Anson, Boeing Aircraft of Canada, Ltd., Canadian Car & Foundry Company Ltd., Canadian Pratt & Whitney Aircraft Company Ltd., Canadian Wright Ltd., British Aeroplane Engines Ltd., Canadian Vickers, Ltd., Fairchild Aircraft Ltd., and Noorduyn Aviation Ltd. A statement showing investments in war aircraft production facilities as of December 31, 1944, is also included. *Commercial Aviation*, November, 1945, pages 36–42.

Air Transport

Planes Over the Pampas. George Herrick. In a study of air-line progress in the Republic of Argentina causes of lag in air-line growth are examined and present air-line facilities are described. It is stated that existent air lines of Argentina need larger and more modern equipment. The part played by foreign countries in the air-line development of Argentina is outlined. The air policy of the republic is discussed. *Air Transport*, December, 1945, pages 22–27, 9 illus.

"Gremlin Task Force." Wing Comdr. L. V. Fraser. An account of how Japanese air crews and aircraft are transporting supplies for the Royal Air Force in Indo-China. As related, the so-called "Gremlin Task Force" consists of 20 surrendered Japanese aircraft, with the Japanese pilots, navigators, and wireless operators functioning under an R.A.F. officer in charge. *Flight*, December 6, 1945, page 612.

Transport Efficiency of Aerial Trains. Pai Shih. The stated purpose of this article is to study the transport efficiency of the aerial train and to develop some definite relations by which its economic advantages can be compared with those of the conventional transport airplane.

Factors affecting the efficiency of air transportation are indicated and a comparative evaluation is made of the different types of aerial train. By mathematical analysis, the writer arrives at the following conclusions: (1) The efficiency factor of transportation—which is directly proportional to the pay load and range, and inversely proportional to the time of transportation and fuel consumed—may be used to compare the transport efficiency of the aerial train. (2) The value of the efficiency factor increases with the number of gliders of the aerial train. For a small aerial train, the efficiency factor varies linearly with the number of gliders. There is an optimum value of the number of gliders beyond which the rate of increase of the efficiency factor decreases. Therefore, in commercial service, the aerial train should consist of that number of gliders which will yield the greatest value. (3) The transport efficiency of the aerial train depends on the characteristics of the towing plane and the gliders. For a given towing plane, large gliders afford greater transport efficiency. Hence, within the structure limitation, it is desirable to use the largest glider in the aerial train. (4) The radius of action of the aerial train is an important characteristic for military operation. *Aero Digest*, December 1, 1945, pages 69, 70, 118, 3 illus.

The French Recovery. L. Graham Davies. The major portion of this report deals with the French international system of postal air services. Routes, capacities, history, equipment, and personnel are discussed. Other brief data in the article are pertinent to the reportedly rapid recovery of the French aircraft-manufacturing industry. *The Aeroplane*, November 23, 1945, page 597, 5 illus.

Air Age Vikings. The history of Norway's civil and commercial aviation is reviewed. It is noted that the first chapters in the history of Norway's commercial aviation were being written when the German invasion halted the development of air transport within the country. The writer describes how the scene of Norway's air development was shifted to foreign shores where aviation, like every other phase of Norwegian life, was pressed into the war effort. Information is given about the Royal Norwegian Air Transport, which was established December 19, 1943, to take up the task of preparing for the postwar resumption of Norwegian civil air transport. *Air Transportation*, November, 1945, pages 7–10, 2 illus.

TCA Spreads Its Wings. A nine-article survey of the organization, history, and operations of Trans-Canada Air Lines. The first article is concerned with the growth of the company, relating its plans for expansion of routes at home and abroad. Present routes are noted, together with new ones planned. Succeeding articles deal with TCA's personnel, passenger service, pilot training, aircraft, maintenance, terminals, communications, and engineering. The final article records the company's history. *Canadian Aviation*, December, 1945, pages 40–56, 58, 60, 84, 112D, 122, 124, 51 illus.

The Future of World Airlines: Australia. Lucien Zacharoff. The ninth article in a series on the commercial aviation potentialities of various countries is concerned with Australia's prospects. The history of civil aviation in Australia before and during the war is outlined, and some of the plans now being laid for the expansion of Australian air transport at home and abroad are related. The particular adaptability of the continent to air transport is indicated; routes and equipment which will be used are noted; and attention is called particularly to the part played by Qantas Airways in the progress of Australian air transportation. *Air Trails*, January, 1946, pages 36, 37, 64, 66, 3 illus.

Refuelling in Flight. C. H. Latimer-Needham. Following two previous articles which discussed Sir Alan Cobham's system of refuelling in flight, this one further examines possibilities of the system in application to transatlantic air transport. It is stated that refuelling in flight is not intended as a substitute for certain weak features that may exist in present-day aircraft, and that the mechanical difficulties of the method have been solved. It is shown further that the costs of flight refuelling are negligible when viewed in relation to the economies that are thereby effected, and that the necessary materials are on hand ready to be employed. Tables of data supplement the study. *Flight*, November 22, 1945, pages 556–560, 6 illus.

Where You Can Fly From Here. Current services operated by air lines from the United Kingdom and available to the public are listed. The air routes are classified under services to and from the United Kingdom; Empire-routes feeder services; and United Kingdom services. *The Aeroplane*, November 30, 1945, page 648.

Airplane Descriptions

Construction of the Shetland. The construction of the Shetland flying boat, joint development of Short Bros. and Saunders Roe, is detailed. Particulars are examined under classifications of hull; flooring; construction joints; wing and tail-plane attachment frames; bulkheads and doors; nose structure; wings; flaps, ailerons, and tail surfaces; flying controls; and power plants. Other information pertains to the fuel system; auxiliary generating plants; operating equipment; air conditioning; mooring; accommodations on upper deck, and accommodations on lower deck. A 2-page drawing illustrates the component parts of the second prototype Shetland flying boat with four 2,440-hp. Bristol Centaurus XI engines. *The Aeroplane*, December 7, 1945, pages 661–667, 6 illus.

The Fleet Canuck. Tom Williams. Data are given on the construction, flying characteristics, design and safety features of a Canadian two-place side-by-side personal aircraft. A development of Fleet Aircraft Limited, the Canuck is said to recover from a spin in either direction quickly and automatically when the controls are released. Flying stability is reported to depend largely on the airfoil section which was chosen to give a high lift-drag ratio, a gentle stall, and quick recovery from a spin. Weights and performance figures for the Canuck are listed. *Commercial Aviation*, November, 1945, pages 58, 60, 62, 3 illus.

The Shetland II. Further details are revealed about the British flying boat, the Shetland II. Features of the wing and ailerons are noted, but the main portion of the article deals with the special electrical assisters with which the flying controls are fitted. The assister unit described is called the Synchromo. Its contact mechanism, indicated as the most ingenious feature of the Synchromo, consists of four geared contact wheels which do not transmit power but serve only as electrical contacts. *Flight*, December 6, 1945, pages 607, 608, 5 illus.

Tiger Moth Components Speed Production of Fox Moths. Descriptive and price information is given for the revised Fox Moth being produced by the de Havilland Aircraft of Canada, Ltd. Weights, performance figures, and dimensions are listed for the five-place aircraft. It is reported that with the exception of the Gipsy engine, the Fox Moth will be built entirely in Canada. It is also stated that a number of Tiger Moth components obtained from the War Assets Corporation will be included in the Fox. The parts include engines, wings, empennage, and tail wheel. *Canadian Aviation*, December, 1945, pages 78, 90, 1 illus.

The Lockheed P2V, designed for the Navy as a peace-patrol plane. It has a range of 3,500 miles with full load and more than 5,000 miles when equipped with fuel tanks in the bomb bay. A wide variety of equipment can be installed for special purposes.

Halifax A-1X Airborne Transport. Brief notes indicate the features of the Halifax A-1X, transport version of the Handley Page bomber. Although designed primarily for use by the Airborne Forces, the A-1X can also be operated as a bomber or a transport, it is stated. Its bomb bay is designed to carry either fuel or supplies. Specifications of the aircraft are listed and several photographs and drawings illustrate its design and construction. *Flight*, November 15, 1945, pages 530, 531, 9 illus.; "Halifax Airborne Transport," *The Aeroplane*, November 16, 1945, page 563, 3 illus.

Planes of the German Air Force. An evaluation of the quality of the German air force and features of its individual planes accompanies a table of the aircraft used by the Luftwaffe. In the table the following data are given for each airplane: manufacturer; designation; typical engines; horsepower each engine; span; length; height; gross weight; empty weight; maximum speed; range; and service ceiling. *Flying*, January, 1946, pages 76, 77, 120, 122.

Hamilcar X. A description of the load-carrying glider, Hamilcar X, stresses the modifications that distinguish the X from preceding Hamilcar types. One of these is the addition of two Bristol Mercury XXXI engines to facilitate take-off and cruising; another is the increase of the glider's total weight from 37,000 lbs. to 47,000 lbs. Civilian uses for the Hamilcar X are suggested. Specifications of its engines are tabulated; and dimensions, weights, and performance figures for the glider are listed. *Flight*, November 15, 1945, pages 532–534, 3 illus.; "The Hamilcar X Powered Glider," *The Aeroplane*, November 16, 1945, pages 573, 574, 3 illus.

Beechcraft D18S. Jean Dubuque. Features of the eight-place Beechcraft D18S transport airplane are described. Powered by two Pratt & Whitney Wasp Junior engines, the plane is reported to have a top speed of 227 m.p.h., a cruising speed of 210 m.p.h., and a range of 1,100 miles. It sells for $59,275, and three different seating arrangements are available.

The developmental background of the plane is traced. Differences between the D18S and its predecessor models are noted. A triple-page schematic drawing is included among the illustrations supplementing the descriptive text. *Skyways*, January, 1946, pages 34–41, 74, 76, 10 illus.

The Martin-Baker M-B V. In a review of the design and construction of the Martin-Baker, this British fighter plane is credited with having a combination of low weight, high power, and good design. Its exceptional accessibility features are indicated as facilitating maintenance. It is powered by the Griffon 83. Some dimensional figures are given and illustrations depict various components of the plane. *Flight*, November 29, 1945, pages 588–590, 11 illus.; "The Martin-Baker Enterprise," *The Aeroplane*, November 30, 1945, pages 615–618, 15 illus.

Planes of the Great War. Aircraft used during the first World War are reviewed. The planes described include British, French, and German types. *Air News*, December, 1945, pages 34, 35, 82, 9 illus.

Bristol 170 Freighter Construction. The design and construction of the Bristol 170 Wayfarer is described. Usable as either a freighter or a passenger airplane for 34 to 40 people, the Bristol 170 is designated as a transport developed for economical operation.

American Airlines System Douglas DC-4, in transatlantic flight.

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What interests the passenger is the ease, comfort and speed of transatlantic air travel, as handled by American Airlines' big Douglas DC-4's. But to the engineer who knows the importance of maintaining schedules and operating efficiency, it's the equipment that counts. An example is the Auto-Lite ignition cable that serves such a vital function in the aircraft's electrical lifeline. Auto-Lite ignition cable, tested and proved in the fighting planes of the United Nations, is available now to make peacetime travel safer and more dependable than ever before.

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It is of all-metal construction, has a fixed undercarriage, and its design obviates the need of special tools for skin repairs. Specific data about the main components of the Wayfarer are given under the respective headings: the wing; the fuselage; the tail; controls; inspection doors; undercarriage; flaps; electricity supply; power plants; fuel tanks; and cabin. Figures relative to dimensions, performance, weights, capacities, etc., are listed. *The Aeroplane*, November 30, 1945, pages 644–647, 8 illus.

Airports and Airfields

Municipal Planning and Airport Management. Leigh C. Fisher. While stressing the necessity for coordination between the city government and the airport management in problems involving a municipal airport, a warning is given against the evils of improper or inadequate delegation of authority, political control or intrigue, and low salaries for airport managers. Duties, responsibilities, and authorities of the airport manager are discussed. A suggested outline for planning and operating a municipal airport is given as follows:

(1) Establish an aviation commission and charge it with responsibility for the construction and operation of the airport in cooperation with the airport manager. (2) Specify the authority of the airport manager and grant him such authority as is necessary to fulfill his duties. (3) Grant responsibilities to the manager for all phases of the airport's operation and supervision. (4) Assure cooperation between the aviation commission and the airport manager on all budgetary, financial, and policy matters, including negotiation of leases and contracts. (5) Assure supervision of the airport by the airport manager without conflict with other city departments or personnel. (6) Insure the position and the salary of the airport manager through municipal civil service. *Southern Flight*, December, 1945, pages 52, 53, 61.

Building the Small Airport. Part VIII. B. Ashburton Tripp. The current installment of an article concerning various phases of small-airport construction deals with the subject of landscaping. Landscape maintenance, the selection of planting material (which, it is stated, should be confined to indigenous shrubs); factors determining the number of shrubs to use; and the question of the proper time to plant are discussed. *Aviation Maintenance*, December, 1945, pages 52, 53, 104, 106, 107, 3 illus.

Plans for the Panama National Airport. C. B. Hall. The projected national airport for the Republic of Panama is described in detail. Particulars are given about the buildings; traffic facilities; public observation facilities; air-line offices; concession areas; administrative and operations sections; runways; hangars; storage buildings and warehouses; parking accommodations; entrance and exit drives; sources of electricity; lights; communications systems, etc. A plan view of the airport is shown. *Aero Digest*, December 15, 1945, pages 52–54, 122, 3 illus.

Portsmouth's Plan for an International Airport at Langstone Harbour. Accompanied by descriptive diagrams, details are given about a suggested plan to construct combination landing facilities for landplanes and flying boats at Langstone Harbour, Portsmouth, England. The scheme has been prepared for three stages of development, the first of which encompasses the enlargement of the existing airport to accommodate Dakota-type aircraft, the dredging of an adjacent mooring basin, and the provision of three water runways over 1 mile in length and with a low-water depth of 10 ft. Temporary landing slips and terminal buildings would be erected close to the main road and electric railway to London. In the second stage of development, the three water runways would be nearly doubled in length and a new land base created on reclaimed land. The erection of barriers across the two sea inlets is provided to ensure a constant water level throughout the harbor, with a minimum low water depth of 15 ft. in three runways and of 12 ft. in the mooring basin and taxi-channels. In the third stage the water runways would be widened and extended by further dredging, and "fill" would be provided to extend the reclaimed area in order to provide for a duplicate set of parallel runways for the landplanes. If necessary, a water runway 18,000 ft. long would be dredged in the direction of the prevailing wind. *The Aeroplane*, November 30, 1945, pages 642, 643.

The Case Against "Absentee" Management. John H. Frederick. The writer cautions municipalities against so-called "services" which advise on problems of airport management on a retainer or fee basis. Describing the methods by which most of these services operate, he claims that much of the advice that they disseminate can be obtained free of charge from various field offices of the Civil Aeronautics Authority or through trade journals. While the condemnation is not extended to all such services, it is pointed out that, at best, this type of absentee airport management is neither adequate nor efficient. *Southern Flight*, December, 1945, pages 56, 57.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Capitalizing on Surplus Airports. Frank Maher. From a survey of approximately 700 communities which will have abandoned military airfields turned over to them, a summary is given of their plans for successful operation of the sites as civilian airports. Following the general policy of using only the portions of the airfields that are needed and concentrating on the private-flying market, communities are reported to be contemplating these general lines of action, among others: leasing of field facilities to competent certified operators who will assume the responsibility of maintaining the fields; stimulating aeronautical training in high schools and other educational groups; enlisting newspaper support to promote private flying; installing picnicking facilities near the airports; leasing of nonaeronautical concessions; and encouraging factories to locate near the airports. The article is accompanied by brief instructions on how and where municipalities and states can apply for "surplus" airfields. *Airports*, December, 1945, pages 26–28, 5 illus.

Ports for the Private Plane: New York City. A series of photographs illustrates airport facilities that are available for personal aircraft around New York City. The landing facilities shown and described are those at Whitestone, N.Y., Flushing, N.Y., Teterboro, N.J., Staten Island, N.Y., Mountain View, N.J., White Plains, N.Y., and Armonk, N.Y. *Flying*, January, 1946, pages 35–42, 90, 93, 16 illus.

"Shine Up" the Airport Terminal! Josh Lee. A member of the Civil Aeronautics Board charges that the accommodations of many airport-terminal buildings in the United States are obsolete, unattractive, and inefficiently operated. He accounts for some of these conditions but urges that they be remedied speedily. *Airports*, December, 1945, pages 33, 34.

The Case for the Defense. Noting typical objections that are raised by people averse to having an airport established in their community, the article suggests answers for use by the proponents of airport projects. In reply to the claim that an airport serves only a limited number of residents, it can be shown that the number of planes representing the capacity of an airport is far less than the number of persons served by the airport. To objections that airports involve danger and noise, sources of statistics are given proving that airports and airplanes are both safer and quieter than other commonly

accepted phenomena of everyday life. Advice is also given on how to refute arguments that airports interfere with the productivity of livestock, decrease the value of agricultural land, reduce the value of residential property, etc. *Western Flying*, December, 1945, pages 41, 73.

Airpark Runway Marking by Reflected Light. A "reflected-light" system for small airports is described. Utilizing "Schotchlite" reflectors and a floodlight trailer, the system was developed by D. W. Onan & Sons, tested at Rochester, Minn., Municipal Airport, and approved by the C.A.A. As reported, the C.A.A. has offered the following conclusions with regard to this airport-lighting scheme: (1) "Schotchlite" reflective markers can be successfully used for landings and take-offs at fields having no boundary lights if suitable floodlights are located at the approach end of the runway or landing strip to obtain the necessary reflective illumination from the markers along the landing strip. (2) Minimum illumination for the markers outlining a landing strip should be two 1,000-watt floodlights. The floodlights should be located 300 ft. from the end of the runway and they must be centered on the runway centerline extended to give maximum effective illumination and reflection from the markers. *Southern Flight*, December, 1945, page 59, 2 illus.

Installing an Airport Drainage System. William C. Slee. A study of some of the principles of airport drainage. Combined and separate systems are described and compared. Advising on procedures to be avoided in installing drainage systems for airports, the writer also discusses developments in underdrains for durability and low-cost maintenance. Among these developments are "Skip-Pipe," semiperforated pipe, and the combination of "Skip-Pipe" with a hood. *Airports*, December, 1945, pages 30, 31, 38, 5 illus.

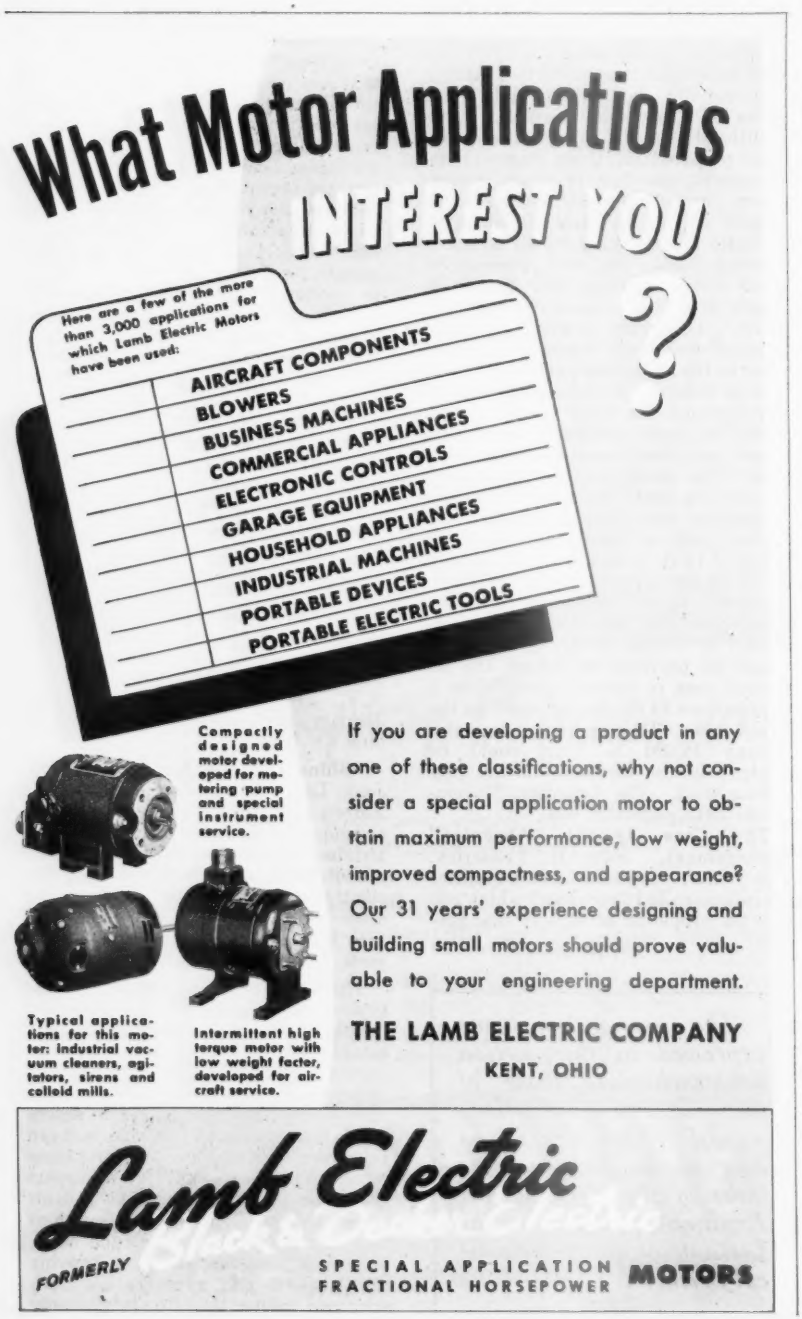
Airports Need a Uniform Tariff. Col. B. C. Allin. A standard schedule of charges for the use of an airport's facilities is urged. Four divisions are suggested for the proposed tariffs: Section A, containing rules, regulations, and definitions; Section B, containing operation fees; Section C, covering passenger fees; Section D, covering cargo fees. An outline is given of the items which it is believed should be included under Sections A and B. *Western Flying*, December, 1945, pages 50, 52, 80, 82.

Floatplane Bases Cut Expenses and Time. Donald D. Cooke. Stressing the need for, and the advantages of, seaplane landing floats, the writer investigates various factors involved in preparing and improving suitable facilities for handling water-based aircraft. Classes and types of aircraft for which water bases are needed; principal points to be considered in establishing a float-plane facility; types of hauling-out equipment; beaching gear; and conditions affecting installations are discussed. In reviewing the principles for establishing waterplane facilities, the writer indicates how economies can be effected with this type of operation. *Aviation*, December, 1945, pages 178–182, 4 illus.

Armament

Aeroplane and Armament Demonstration. A report is made of an armament demonstration that took place at Boscombe Down several months ago. In addition to an account of special bombing and firing techniques which were exhibited by various bomber and fighter aircraft (mainly British), the article includes descriptions of the following items: blaze bombs, which are simply ordinary drop tanks with slight structural changes and two grenades fused to ignite on impact; an antiricochet parachute attachment for a bomb; 90-lb. semiarmor-piercing rockets; various types of fighter armament; target markers used by Pathfinders with 250-lb. and 1,000-lb. indicators and clusters of flares; and statically projected rockets. *The Aeroplane*, November 23, 1945, pages 598–601, 12 illus.

O Vybore Aviatsionnogo Oruzhiia dlia Deistviia po Bronetseliam (On the Selection of an Aircraft Weapon for Ac-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tion Against Armored Targets). G. V. KHmelevskii. The fundamental conditions necessary for efficient attack against armored targets on the ground are outlined as a guide to the airplane designer and as an aid to the pilot in selecting a definite method of attack. Ranges, firing, and pull-out altitudes are tabulated for a FW 190 airplane at various diving angles, flight velocities, and loads. From this table a graph is constructed, showing the variation of the mean firing range in relation to the diving angle. The impact velocity and armor-piercing characteristics of projectiles of 15-mm. and 20-mm. caliber, fired from automatic weapons of the MG-151 type against armor plate of various thicknesses, are computed from ballistic tables compiled by the Soviet Air Force Academy and by De Marre's formula. The data calculated by the writer are applied to problems of armament selection and tactical employment of aircraft. *Tekhnika Vozdushnogo Flota,* February, 1945, pages 26–28, 38, 4 illus.

Avigation

Finding the Navigational Stars. Part XII. Ben C. Kenny. The twelfth in a series about the stars used for celestial navigation explains the system of notation employed to designate the varying degrees of brightness, which are expressed by numbers known as magnitudes. The unit of magnitude is defined, as well as the terms "first," "second," and "third" magnitude applied to the brightness of stars. The numbers are in inverse numerical order, a star of 6.0 magnitude being about the dimmest star visible to the naked eye, while a star of 1.0 magnitude is 100 times as bright as one of 6.0 magnitude. Two stars are so bright that their magnitude is expressed in negative numbers, these being Sirius, of −1.6 magnitude, the brightest star in the universe, and Canopus, of −0.9 magnitude. Nine other stars of the first magnitude are listed, with their magnitude numbers.

A night photograph of the southern sky lying within 42° of the south celestial pole is reproduced, with a diagram, showing the location of the navigating stars Canopus, Epsilon Argus, and Miaplacidus. Another body in the same area is the constellation Crux, also known as the Southern Cross, which contains three navigating stars, Acrux, Beta Crucis, and Gamma Crucis. East of the Southern Cross, Alpha and Beta Centauri establish a line pointing to it. Alpha Centaurus is known by the name Rigil Kentaurus, and to the east and south of that star is the constellation Triangulum Australe, whose brightest star is listed as the navigating star Alpha Tri. Aust. The fifty-fifth and last navigating star to be described in the series is Achernar, in the constellation Eridanus.

The series of articles closes with an appraisal of the future utilization of celestial navigation as affected by the development of radar, which has eliminated its use for certain purposes. The writer states that celestial navigation may be completely displaced in time by more exact scientific methods, acknowledging that it has limitations but holding that it has the redeeming quality of being in its basic principles the simplest means of finding a position. Its freedom from reliance on the proper functioning of mechanical instruments, other than the sextant, octant, and a timepiece, recommends the method for use in emergencies and for economy. Although it may eventually be driven from the field of everyday use by more convenient methods, it is still an important factor and is likely to continue in use by private fliers and as a dependable secondary method. *Aero Digest,* December 15, 1945, pages 62, 132, 2 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Navigating the Light Plane with the Loop. Stanley Hall. The principles and advantages of navigating a light plane with the directional loop are demonstrated. As a practical example of the use of the manual loop on a typical cross-country flight, a hypothetic light-plane trip is traced from Amarillo, Tex., to Oklahoma City. On this trip the loop is employed in its varied uses. *Western Flying,* December, 1945, pages 38–40, 64, 66, 67, 4 illus.

Business and Finance

Proposes Standard Airport Accounting. J. M. Cunningham. A standard system of accounts is recommended for the use of airports. Principles and operation of the scheme are outlined. As developed for the City of New York and published by the Municipal Finance Officers Association, the system is reported to emphasize the determination of an accurate profit-and-loss record. The main groups of revenue accounts are divided into (1) aviation revenues; (2) concession revenues; (3) revenues from airport management sales and services as distinguished from those from concessions; and (4) miscellaneous revenues. The main classifications of expenses fall into functions of (1) maintenance and repair—of field area; hangars; lighting and communications; seaplane walls, floats, and channels; public areas; terminal buildings; service equipment; (2) cost of management sales and services; (3) general and administrative expenses. *Airports,* December, 1945, pages 35, 36.

Airline Earnings Peak Six Months Off? Raymond L. Hoadley. In an analysis of the market trend of airline securities, the writer predicts that the present upward swing probably will continue until the summer of 1946, when it will reach its apex. Among the reasons given for the expected termination of the upward trend are a decrease in pay-load factors and the necessity for financing additional new equipment. The continuation of the trend until the summer is accounted for by such factors as the favorable excess-profits tax situation and a generally optimistic attitude on the part of airline stock investors.

A brief summary of the record of airline securities during 1945 is included, in which it is indicated that it will be shown that an "all-time high" was established during that year. However, two air lines are named as exceptions to that expectation, for which reasons are given. *Aviation,* December, 1945, pages 195, 251, 252.

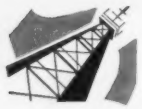
The Outlook Based on 34,000 Engine Orders. C. J. Reese. Some of the plans of the Continental Motors Corporation for future airplane-engine production are outlined by the President of the company. As reported, the program includes increased tooling, lower repair costs, greater production, and design improvements. Based upon reported engine orders, production of between 35,000 and 40,000 personal planes, valued at nearly $100,000,000, is predicted for 1946. *Southern Flight,* December, 1945, pages 32, 33.

Camouflage

Red Herrings for Luftwaffe. It is related how British airfields, factories, and cities were protected from Luftwaffe air attacks by a country-wide system of decoys. Details pertain to "dummies" which helped safeguard the airfields and factories, and to so-called "Starfish" decoy fires which helped protect the cities. *Flight,* November 29, 1945, pages 571, 572.

Civil Aviation

Our Plans for 1946. T. P. Wright. The Civil Aeronautics Administrator outlines the bureau's program for stimulating and improving aviation during 1946. Some of the items on the agenda are simplification and continuous improvement of Civil Air Regulations; encouragement of needed improvements in personal-plane design; increase of personnel and decentralization of administration in the C.A.A.; reinstatement of the Civil Pilot Training Program; cooperation on a Federal-aid airport program; development of cross-wind landing gear; expansion of work on airways facilities; stimulation of adaptation to civil use of war-developed devices; and establishment of new



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foreign offices for international air transportation.

Other plans concern the application of radar to civil aviation and further development of many radio aids; extension of the changeover to very-high-frequency radio facilities; assumption of the operation of aviation facilities in Alaska; continuation of studies and analyses for the industry and the public; and technical assistance to elementary and high schools educating youth in aviation. *Flying*, January, 1946, pages 21, 22, 104, 106, 1 illus.

Electronics in Aviation. A. M. Low. A survey of electronic instruments and facilities originally developed for wartime aviation which will do much toward making civil flying safer, more completely serviceable, and more popular. The developments mentioned include radar; an electronic indicator of ice formation; an electronic carburetor control and "knock" detector for the automatic adjustment of the engine feed; an electronic-type compass which shows not only the direction but the location of the aircraft; a dual automatic compass that computes latitude and longitude and enables the pilot to fix his position from any two stations by means of the azimuth indicator.

Other devices noted are an electronically operated scanning screen that enables the controller in an airport traffic-control tower to determine the positions of all aircraft within a given radius of the airport; the cathode-ray tube in the aircraft itself for the indication of distances between the plane in which the instrument is fitted and other aircraft in any direction within fixed vertical limits; a sealed aneroid capsule apparatus for varying the frequency of the airplane's transmitter to conform with changes in altitude; and electronically operated collision-warning devices. *Commercial Aviation*, November, 1945, page 66.

Fixed Base Air Carriers. Leighton Collins. An interpretation is given of the proposed new Exemption Order and Part 42.00 of the Civil Air Regulations concerning nonscheduled air carriers, prepared and recommended by the Civil Aeronautics Board. The writer explains what the new regulations would mean to the charter operator in terms of possibly increased business, economic regulation, areas over which nonscheduled lines can fly, competition with the air lines, operations, and aircraft requirements. *Air Facts*, January, 1946, pages 77–81.

Insect Spraying for Profit. Robert C. Blatt. An account is given of how a former Thunderbolt test pilot built up a profitable business by converting surplus N3N Navy training planes to use in a mosquito-spraying service. How the spraying equipment is installed on the plane is described and illustrated. *Aviation Maintenance*, December, 1945, pages 39–43, 125, 126, 18 illus.

Obligatory Standards for the Operator? Jerome Lederer. In the interests of public safety, state and municipal regulation of aircraft operators is advocated. Suggested standards to which operators should be required to conform are outlined, and a Board is proposed which would conduct a survey of each operator's business activities pertaining to aircraft, hangar and shop, operations, and field. In addition to an examination of the operator's knowledge and facilities for operating safely, it is also recommended that the Board examine his financial responsibility, service facilities, accounting system, etc. *Airports*, December, 1945, pages 53, 54.

Companies

Intra-State Airline. Tish Erb. The record and operations of Zimmerly Airlines, an uncertified air-carrier service functioning in the state of Idaho, is reviewed. Besides data about the operator, the company's equipment, and charges, this article contains information about the number of passengers carried, the mileage covered, and proposed plans to expand the Zimmerly service to a regional air carrier operating under the title of Empire Airlines. *Western Flying*, December, 1945, pages 54, 76, 3 illus.

Control Equipment

"Pushbutton" Flight Control. Gordon T. Rosholt. Details are reported about a new autopilot developed for the commercial air-line market by the Minneapolis-Honeywell Regulator Company. It is stated that the new model employs the same electronic circuits and mechanical principles used in the manufacturer's Type C-1 autopilot, but incorporates new features and reduced weight. The technical improvements, which augment the pilot's capabilities and are intended to provide increased safety, are described. The operation of the autopilot and the components of the system are explained. *Industrial Aviation*, December, 1945, pages 11, 12, 14, 15, 66, 67, 9 illus.

Basic Principles of Servos. W. E. Hick. An explanation is given of the principles on which is based the operation of aircraft servo mechanisms. Sections are devoted to input, output, and error in servo mechanisms, stability and oscillation, persistent error or droop, integrals and differentials, and response characteristics. Auxiliary servo mechanisms also are discussed. *Aeronautics*, December, 1945, pages 34–39, 7 illus.

Design

Design Planning and Scheduling in Complex Computer Development. A. F. Wild. An analysis is made of the methods and scheduling adopted by engineering management to permit the development of a new and more efficient design of computer for aircraft use in $4\frac{1}{2}$ months with inexperienced designers and draftsmen. Charts show the engineering setups during the roughing-out stage and the design stage. The computer for the Superfortress gunfire-control system is the project described and illustrated. *Product Engineering*, December, 1945, pages 817–820, 6 illus.

Fact vs. Fiction Behind the Twin-Engine Cessna. A. H. Knouff. In an evaluation of the characteristics of the UC-78, the airplane is defended against reported criticisms of its performance and structure by military pilots accustomed to combat aircraft, and its good performance and low operating costs are praised. Suggestions are offered for operating the UC-78 so as to obtain the best results. *Southern Flight*, December, 1945, pages 37, 70, 1 illus.

Analyzing the Aspects of Future Flight. Part II. C. E. Pappas and M. G. Harrison. Concluding a two-part investigation of design factors involved in high-altitude, high-speed flight, attention is given to the streamline pattern of a wing in supersonic flow. The wing should be so designed and located that the influence of the Mach wing-tip cone, when extended, does not fall within the location of the tail surfaces, in order to avoid serious interference effects.

Carrying on the study to include conditions at extreme altitudes and speeds, consideration is given to the possibility of projectile flight, with the airplane attaining high velocity during its passage through the atmosphere and continuing as a free body, possibly assisted by rockets. Calculations of the flight path and of the velocities and energies required for projectile flights to various distances are made, with the

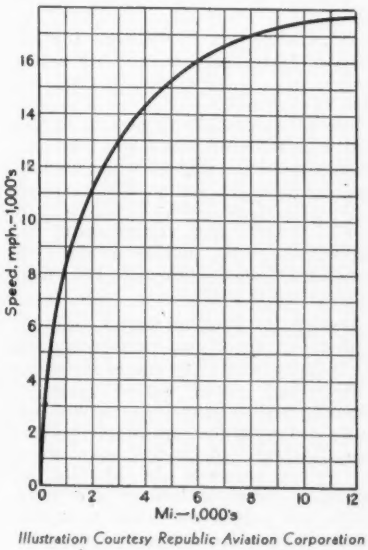

Illustration Courtesy Republic Aviation Corporation

Actual speed required for projectile flight on the surface of the earth, plotted against distance traveled.

aid of algebraic expressions, charts, and diagrams.

Other phenomena affecting flight at extreme altitudes are studied, including pressure, density, temperature, composition of the atmosphere, presence of ions and meteoric dust, and electric charge on a body. Computations are given for the heating effects on the surface of a body resulting from the recombination of ions and of the storage of electrical energy, effects of solar radiation and energy from the earth, and of the possibility of collisions with meteoric particles. *Aviation*, December, 1945, pages 158–162, 11 illus.

To-Morrow's Light Aircraft. Roger Tennant. A discussion of some of the major problems facing designers of postwar light aircraft. Conflicting claims of "wood or metal," "high-wing or low-wing," "pusher or tractor type," and "comfort and safety versus performance" controversies are investigated. Consideration is also given to different types of landing gear, engine combinations, and propeller variations which present themselves as alternative possibilities to the light-plane designer. *Flight*, November 22, 1945, pages 545–547, 554, 6 illus.

Wood vs Metal Construction in Aircraft. Herb Rawdon. The relative advantages of wood and metal as materials for aircraft construction are discussed in this extensive paper. The comparison was made possible through the circumstance that the writer's company was building a plywood-covered plane for the A.A.F. at the same time that it was producing an all-metal plane of comparable dimensions and in similar quantities. Problems involved in producing plywood-covered aircraft are described and compared with similar problems that have occurred in the building of all-metal planes. *SAE Journal*, December, 1945, pages 691–712, 718 (Transactions), 31 illus.

Who Makes the Pilot's Mistakes? Lt. Jerome S. Hardy. Several suggestions are offered for improving the design of the airplane and its accessories, with a view toward reducing the opportunities for "pilot error." These recommendations pertain to flap and gear switches which are less confusing; restricted controls which obviate the chances for losing flying speed, making "stall-ins," etc.; better forward vision range; and improvement of flight instruments, such as the compass and the artificial horizon. *Air Facts*, January, 1946, pages 9–11.

Design for Profit. Part I. H. G. Lesley. A three-part article studies the possibilities of redesigning transport-aircraft parts with a view to speeding maintenance, cutting ground time, and achieving maximum utilization of a fleet. In the first installment the writer discusses the increase of utilization accomplished by operators in the war years; the extent to which advancements in electronics may contribute to higher utilization of aircraft; the delay caused by cargo-handling operations; passenger delays; refueling delays; and mechanical delays. A chart shows the percentage of delays caused by the necessity for service work on different sections and systems of an aircraft. Other charts compare the utilization factors and flying-time ratios of transport airplanes. *Air Transport*, December, 1945, pages 50, 53, 54, 56, 61, 62, 6 illus.

Landing Analyses for Flying Boats and Seaplanes. Part III. Ernest G. Stout. Landing stability and skipping are considered in the third section of a serial article about certain phases of the design of water-based aircraft. The writer states that wartime conditions involving the operation of flying boats from crowded bases, at night, with heavy overloads, and under other handicaps, made it necessary to overcome tendencies toward hydrodynamic instability and "skipping" upon landing, and that postwar commercial operations will entail similar needs for improved landing characteristics. The general physical aspects of skipping, some of the predominant variables involved, and their effects upon that phenomenon are outlined.

The forces acting on the hull of a flying boat when alighting on the surface of the water are analyzed with respect to the flow of the water, the influence of the forebody, the steps, and the afterbody. The action of air entering the space aft of the step has an effect on the trim of the hull and its behavior, necessitating the provision of means for ventilation and ducting of the bottom of the hull. An explanation is given of how the design of the bottom of the hull is tested by the use of models in the towing basin, establishing the basic hydrodynamic characteristics. The test program is described in detail, and conclusions regarding the correct procedures for designing a hull that will not skip are summarized. A typical example is given of the application of the results of the study to the design of an actual flying-boat hull. *Aviation*, December, 1945, pages 163–166, 6 illus.

Market for Amphibians Grows. John E. Cregier, Jr. The merits of the twin-engined amphibian plane for meeting utility requirements are commended. It is claimed that the amphibian's so-called limitations from the standpoint of price, range, cruising speed, and economy are more than offset by its greater usefulness as a medium of transportation than the conventional land-based aircraft. The writer also endeavors to prove that the utility factor is greater than any other consideration on the part of the plane-buying public. *Airports*, December, 1945, pages 44–46, 3 illus.

Design Analysis of the Constellation. Design, engineering, and construction details of the C-69 Constellation are surveyed. Following a general description of the aircraft and its specifications, particulars are noted relative to its wings, fuselage, fuel tanks, engine nacelles, controls, ailerons, flaps, and hydraulic system. Other information pertains to the empennage, rudder, elevators, cabin, pressurization system, landing gear, power plants, propellers, and instruments. Supplementing the data are drawings of the engine controls and throttle, empennage assembly, wing assembly, cooling system, rudder-control system, power plant, main gear assembly, and fuel shut-off controls. *Air News*, December, 1945, pages 53–57, 8 illus.

Design Details of the Northrop P-61. Part II. The second part of an engineering analysis of the Northrop P-61 is concerned with particulars of the armament, radar equipment, electric power, and hydraulic system. It also details the design of the engine nacelles, landing gear, controls, and automatic pilot servo unit. Sectional drawings illustrate various components and assemblies of the airplane. *Aero Digest*, December 1, 1945, pages 50–54, 117, 9 illus.

Electrical Equipment

Resonant-Circuit Constant-Current Regulators. G. M. Kevern. The writer discusses the development of resonant-circuit regulators for brightness control in airport-approach and runway-marker light circuits. It is noted that resonant-circuit regulators have no moving parts and operate at high efficiencies and power factors, even at light loads. Detailed performance data, together with a comparison of resonant-circuit and moving-coil regulators, are supplied in this paper. *Electrical Engineering*, December, 1945, pages 807–810, 9 illus.

Aircraft Circuit-Breakers. C. H. Flurscheim and J. A. Nott. Reference is made to the marked increase in the electrical power demand in aircraft, which has brought about wide modification in power distribution, increased the importance of electrical services, and opened the field for circuit-breaker distribution affording built-in automatic protection. It is stated that, as aircraft extend in size, it is to be expected that circuit breakers with separate relay protection will become both practical and advisable on the more important circuits. The advantages offered by replacing switches and fuses with circuit breakers are summarized with reference to the conditions under which protection is required.

Special requirements for aircraft circuit breakers are described. Consideration is given to factors involved in the design of circuit breakers for aircraft electrical systems. A typical application of circuit breakers to an aircraft electric installation is illustrated. Oscillographs and oscillograms made in connection with circuit-breaker tests also are shown. *The Journal of The Royal Aeronautical Society*, November, 1945, pages 663–679, 8 illus.

Parallel Operation of Main-Engine-Driven 400-Cycle Aircraft Generators. L. G. Levoy, Jr. A description is given of the progress that has been made in the development of variable-ratio drives and governors for parallel

operation of aircraft alternators driven from the main engines. Information is supplied about preliminary tests of such drives under various conditions of acceleration and loading. The general system of operation and the results of the tests are described. *Electrical Engineering*, December, 1945, pages 811–815 (Transactions), 15 illus.

Selenium Rectifiers in Aircraft. Alvin L. Embry. The possible advantages that may be derived from the use of selenium rectifiers as a source of d.c. power in aircraft equipped with a.c. power systems are considered. The construction and characteristics of the selenium rectifier cell are described. Information is given about different applications of the rectifier. Features of a voltage-regulated rectifier unit are explained with the aid of a diagram. *Industrial Aviation*, December, 1945, pages 34, 63, 3 illus.

Matching the Engine and Generator of Aircraft Auxiliary Powerplants. H. J. Finison. The requirements for a satisfactory auxiliary power plant for large aircraft are reviewed from the standpoint of the selection of properly matched units to provide the necessary capacity without undue weight and complication. Best results are obtained by matching the electrical characteristics of the generator with the mechanical characteristics of the auxiliary engine in such a way as to provide the normal power for ground operations during maintenance routines, as well as the peak power required to meet heavy intermittent loads, such as starting the main engines. An instance is mentioned of such extreme mismatching of engine and generator that the load of starting the main engines caused the auxiliary power plant to stall. The causes of unsatisfactory performance of power plants of apparently adequate capacity are analyzed, with information concerning the results of a careful investigation of the characteristics of the generator and engine. Examination of the individual characteristics gives a complete and accurate picture of the results of improper matching of those units and leads to the determination of means for assuring proper matching of the machines.

The remedial measures are described as including the provision of proper values of resistance in the generator field, selecting the proper speed ratio of engine and generator, current regulators, and voltage regulators. Each method has advantages and limitations, which are outlined, and the methods of matching are compared. *Aero Digest*, December 1, 1945, pages 77–79, 125, 126, 8 illus.

Engines

Napier Sabre VII. A description of the Mark VII Napier Sabre aircraft engine, with changes and modifications from preceding models indicated. As reported, the Sabre VII produces over 3,000 b.hp. at take-off. Among its differences from previous Sabre types is the increased physical capacity of the blower impeller in conjunction with water/methanol injection equipment, strengthened components, modified controls, and a redesigned cylinder head.

Supplementary to the particulars about the Mark VII is an outline of Sabre development up to the latest model. There are also various illustrations depicting the features of the Mark VII and a table of specifications. *Flight*, November 22, 1945, pages 550–553, 7 illus.

Injection of Anti-Detonating Fluids in Aircraft Engines. The injection of antidetonating fluids into the inlet manifold or cylinders of engines to permit higher mean effective pressures and greater specific outputs is discussed. The article has particular reference to activities of the Wright Aeronautical Corporation in this direction, and to German developments in power boosting systems as revealed in papers on the subject. Details are given about the water-injection equipment developed for Wright engines in 1942, and tests of this equipment. The injection equipment used on the German BMW 801 D engine is described.

Consideration is given to precautions that must be taken when fitting injection equipment to engines; the relative merits of different coolants; and the effect of internal-cooling media on engine performance. *Automotive and Aviation Industries*, December 1, 1945, pages 34–36, 38, 76, 78, 80, 84, 8 illus.

Slow-Motion Study of Injection and Combustion of Fuel in a Diesel Engine. Cearcy D. Miller. The results are given of a study of still prints from motion pictures taken at the rate of 40,000 photographs per sec., which show the injection and combustion of fuel in a Diesel engine as observed through glass windows mounted in the cylinder head. The various events, when seen on the motion-picture screen, are slowed down to 2,500 times their true duration. Results are compared with single-orifice fuel-injection nozzles. Relations are demonstrated between injection-advance angle, ignition lag, fuel vaporization, smoke formation, and Diesel knock as characterized by quick inflammation of the fuel charge. *SAE Journal*, December, 1945, pages 719–735 (Transactions), 15 illus.

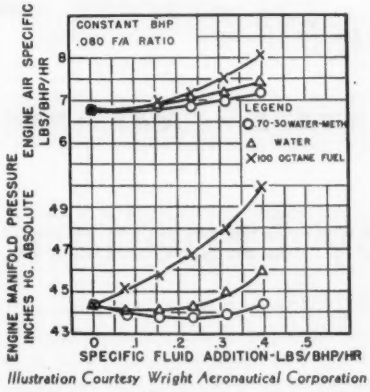

Illustration Courtesy Wright Aeronautical Corporation

Effect of antidetonant-injection rate on cylinder-head temperature and manifold pressure of an aircraft engine.

Bristol Theseus I. The design, construction, and operation of this combination gas-turbine and propeller unit are investigated. Credited with high power and low fuel consumption, the Theseus I is described as consisting of a compound multistage compressor which inspires air through an annular orifice around the propeller reduction gear. From that point the compressed air then is delivered through a heat exchanger before passing to the combustion chamber, where its temperature is further raised by the burning of injected fuel. The resulting products of combustion pass to a turbine by means of which the compressor and auxiliaries are driven, and thence to a further turbine stage which, through a forward extension shaft, drives the propeller. After leaving the latter turbine the gases pass through the heat exchanger, where they yield a measure of their heat to the compressed air on its way to the combustion chambers. From the heat exchanger the exhaust gases are finally discharged through a controllable nozzle, thus providing a certain proportion of the total thrust. The Bristol company's work with gas turbines is reviewed. *Flight*, December 6, 1945, pages 597–599, 4 illus.

Aircraft Engine Progress. Col. Donald J. Kiern. A study is made of the progress in the development of military aircraft engines as revealed by a chart showing the increase in b.hp. for different models by years, from 1936 to 1945. Conditions affecting advancement in horsepower are discussed. It is noted that the war period accelerated and intensified the trend to higher horsepowers but, until water injection was adopted, the question of increased fuel quantity versus fuel quality almost forced a slowing of the upswing in power during this period. *Automotive and Aviation Industries*, December 1, 1945, pages 42, 66, 1 illus.

Amortizatsiia Vintomotornykh Ustanovok (The Damping of Propeller-Engine Installations). I. V. Anan'ev. The causes of vibrations in propeller-engine installations and methods of their elimination are examined. A survey is made of the disturbances that can be caused by the engine and the propeller, of the forms and frequencies of the oscillations characteristic of engine installations, and of the more effective methods for the isolation of the impulses. The writer presents recommendations for the design and

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construction of engine dampers and mounts. *Tekhnika Vozdushnogo Flota*, May, 1945, pages 5–11, 11 illus.

High-Conductivity Cooling Fins for Aircraft Engines. J. W. Cunningham. Particulars are given about a program initiated by the Wright Aeronautical Corporation to develop ways of applying high-conductivity (that is, copper and aluminum) fins to cylinder barrels to take the place of the integral steel fins on the cylinder barrels of air-cooled engines. The program was initiated in 1939 because increases in the take-off hp. of air-cooled aircraft engines had made it imperative that methods of obtaining more efficient cooling be devised.

Various methods of attaching these fins are investigated, and the advantages of each method are described. *SAE Journal*, December, 1945, pages 742–748 (Transactions), 12 illus.

Atomic Engines. Willy Ley. The possibility of applying atomic energy to the propulsion of aircraft is considered. As a prelude to the discussion, an outline is given of the way energy is released through the nuclear fission of uranium. Consideration is given to the use of atomic energy for the production of steam to operate turbines located in the wings of an airplane. The advantages that might be realized from such an arrangement are outlined. *Air Trails*, January, 1946, pages 24, 25, 72, 74, 7 illus.; "The Mighty Atom," by Group Capt. D. C. M. Hume, *Canadian Air Cadet*, December, 1945, pages 14, 21; "Atomic Energy," by Louis Bruchiss, *Air News*, December, 1945, pages 40, 41, 84, 4 illus.; "Nature and Portent of Atomic Power," by W. F. G. Swann, *Aero Digest*, December 1, 1945, pages 33–37, 113, 114, 3 illus.

Razzhizhenie Aviamasla Toplivom (The Dilution of Oil with Fuel). P. P. Korolev and V. D. Revo. Winter operation of airplanes makes it necessary either to pour off the oil from the oil system (which is made difficult by the freezing of the oil), and pour in hot oil before starting the engine, or, in the case of special winter oils, to warm them up before starting the engine. Introducing 10 to 15 per cent by volume of gasoline to the oil before stopping the engine is proposed as an effective method of changing the properties of any kind of mineral oil at low temperatures, permitting the starting of airplane engines without preliminary warming up of the oil. The volatility of the oil is considerably increased and, with the engine warmed up in 20 to 25 min. of operation, the gasoline is almost fully evaporated and the original properties of the oil are returned. The oil is diluted by means of a special gasoline line with a valve to allow the transfer of the gasoline into the oil line. The performance and wear of aircraft engines using diluted oil is also discussed. *Tekhnika Vozdushnogo Flota*, February, 1945, pages 16–19, 22–25, 12 illus.

Flight Operations

Trade Tricks Speed CAL Flight Control. Stan Johnson. A description is given of ingenious devices used in the Denver, Colo., flight-control office of Continental Air Lines to simplify operations. These include a trip-follower card, which replaces the long blackboard used to record this information; a capacity relay, used as a signalling device between the flight superintendent and the radio operators; a clock that can be adjusted so that it will turn on a reminder-signal light at any quarter hour of the day; and a crew-position board. *Air Transport*, December, 1945, pages 67, 68, 71, 6 illus.

Flight Technique

Welcome, Pilot! William H. Champlin, Jr. An airplane operator points out to ex-military pilots some of the factors in aircraft operation with which they may have special difficulty when preparing themselves to fly light planes again and gives advice on how to overcome the problems quickly and smoothly. Among the items to which attention is called are operation of the power-plant controls; operation of the throttle; carburetor ice; flying close to trees on the downwind side of a hill; forced landings; and aerobatics. *Air Facts*, January, 1946, pages 31–33.

How to Fly the Constellation. Advice is given about the flying and handling characteristics of the C-69 Constellation. Procedures are outlined separately for the pilot, copilot, and flight engineer. In describing techniques for each of the three to follow, flight phases are divided into checking, preparatory to take-off; starting the engines; taxiing and take-off; climbing; level flight and cruising; preparations for landing; landing. Instruments included in the flight engineer's control panel and pilot's control stand are tabulated in two supplementary lists, and illustrations of these two control units are shown. *Air News*, December, 1945, pages 47–49, 88, 89, 5 illus.

The Stall Landing . . . Capt. Warren H. Goodman and John R. Hoyt. These are two opposing articles in discussion of one formerly published titled, "Is the Stall Landing Obsolete?" Protesting the conclusions arrived at in the original article by the latter-named author above, the first of these two articles upholds the merits of the stall landing. It refutes arguments that the stall landing is inherently unsafe, inaccurate, and harder on the airplane. Instead, the writer sets out to show that wheel landings cannot be compared with stall landings "speed for speed" because a stall landing results in a slower touch-down than a wheel landing.

In the second of the current two articles, the writer of the original thesis clarifies and enlarges upon his contentions that a stall landing is contrary to the safest, easiest, and best method of landing an airplane. He presents eight different points in support of the statement that, while stall landings may be all right for emergency purposes, they cannot be compared with wheel landings for safe, easy, and accurate performance. *Flying*, January, 1946, pages 30, 31, 106, 108, 110, 4 illus.

Fuels

Knock Ratings of Gasoline Substitutes. Afton D. Puckett. A report is made on a portion of an extensive investigation of substitute motor fuels conducted by the National Bureau of Standards. Knock ratings of gaseous paraffins and olefins of specified carbon content, and of carbon monoxide, were determined by current motor-fuel and aviation-fuel test methods. Auxiliary apparatus and modifications of test engines necessary to rate gases are described. Antiknock qualities of ethyl and normal butyl alcohol and acetone, both alone and in blends, were determined by current motor-fuel rating procedures. Blending characteristics of these materials with straight run gasolines and naphthas were investigated.

The tests indicated that blends containing up to 45 per cent of ether should give relatively knock-free performance under conditions of steady operation. *Journal of Research of the National Bureau of Standards*, October, 1945, pages 273–284, 9 illus.

Gliding and Soaring

A Design for Power Soaring. Elton H. Rowley. Problems connected with the design of a power plant for a glider built by the writer are outlined. Seven requirements for power soaring are listed. An analysis is made of how these requirements could be met. *Soaring*, November-December, 1945, pages 14, 15, 1 illus.

The Glide Inn. P. A. Wills. It is noted that the R.A.F. has formed, or is forming, no less than twelve gliding clubs in Germany, using German sites and equipment. A description is given of the 84 Group Gliding Club, at Gitter, which is the club in the most advanced stage of development, and which at present is functioning more as a gliding school. Information is supplied about modern German sailplanes. Current R.A.F. gliding activities in Germany are described. *Aeronautics*, December, 1945, pages 28–33, 15 illus.

The Glider Tow. Harry Vernon and Zenas Savage. The writers describe a glider-tow vehicle which they developed in an effort to simplify the launching of gliders and to cut ground equipment and the ground crew to a minimum. A double transmission was improvised which would serve as a drive for a tow truck and a winch. Particulars are given about the construction and operation of the glider tow. *Soaring*, November-December, 1945, pages 16, 17, 4 illus.

General Glider Performance. H. T. Nagamatsu and M. Masaki. General formulas and charts are supplied for determining glider performance in terms of the fundamental parameters, the span, and the parasite loadings. The charts have been developed to make the determination of glider performance simple and rapid. To obtain the performance at the minimum angle of glide and minimum sinking-speed conditions, two separate charts are developed with the fundamental parameters as the independent variables. A generalized chart with the indicated speed as an independent variable is developed for determining the general performance. The sinking speeds caused by parasite and span loadings can be obtained for any indicated speed. Also, the variation of performance caused by a change in the design parameter can be seen from the chart. *Soaring*, November-December, 1945, pages 8–13, 17, 5 illus.

The LNE-1. Capt. Ralph S. Barnaby. Information about the performance and operation of Pratt-Read Navy LNE-1 two-place sailplanes is given by a pilot who has logged many hours in them under gliding and soaring conditions, as well as in tow. Some particulars are given also about the design of these gliders, and the important specifications are listed. *Soaring*, November-December, 1945, pages 2, 7, 3 illus.

Instruments

Instrument Panel Lighting Design and Development. Col. T. B. Holliday. Methods and requirements for aircraft instrument-panel lighting are described in this article. Consideration is given to means of providing sufficient light to permit reading of the instruments without affecting the adaptation of the eye to darkness. The use of self-luminous paint, direct and indirect lighting in the instrument panel, individual lighting of instruments, and ultraviolet lighting are discussed. *Product Engineering*, December, 1945, pages 838–840, 4 illus.

Landing Gear

Computation of the Axis of Rotation of Retractable Landing Gear. E. Katzberg. A method is presented for finding the axis of rotation for a plane rotated in space, as in the case of a retractable landing gear. The method described endeavors to shorten the graphic solution of the problem by utilizing only one view. It is claimed that a result of this direct approach is the reduction of chances for error in line construction. Included in the article is a brief trigonometric solution which follows the graphics directly. The mathematical computations are supplemented by diagrams. *Aero Digest*, December 1, 1945, pages 62, 63, 6 illus.

Issledovanie Dinamiki Aviakoles pri Manevrakh Samoleta na Zemle (Investigation of the Dynamics of Airplane Wheels During Motion on the Ground). T. M. Bashta and I. P. Tolstykh. Experiments were conducted on airplanes with wheels of the following sizes: 600 by 180, 900 by 300, and 1,100 by 400 mm. Landings were made on concrete runways and on dry grass at speeds up to 200 km.p.h. Investigations were made on the dynamic compression of the tires, the rotation of the wheels caused by contact with the ground, the dynamics of the wheels during rolling, the deformation of the tires during acceleration and deceleration of the airplane on the ground, and the coefficient of friction of the tires on concrete runways. The test equipment, methods, and results are discussed. *Tekhnika Vozdushnogo Flota*, February, 1945, pages 1–6, 9 illus.

Maintenance

Retraining Is the Answer as Maintenance "Goes Diverse." Albert G. Thomas and Allan Merkin. An account is given of how the Atlantic Division of Pan American World Airways is accomplishing the simultaneous servicing of various types of aircraft, necessitated by the postwar transition period during which the company is using old-type planes, new ones, and converted models. The maintenance program is based primarily on two factors, both of which are detailed—one is a system of mechanic retraining, the other a scheme of shop replanning. *Aviation*, December, 1945, pages 112–114, 4 illus.

Maintenance Principles for Gas Turbine Jet Engines. John Foster, Jr. With attention called to the specialization necessitated by the high speeds and close tolerances of gas-turbine jet power plants, fundamentals of servicing and maintaining these engines are outlined. Overhaul and inspection procedures are advised relative to the rotor assembly; impellers; nozzle shroud ring, combustion chambers, fuel system; exhaust tail cone; and accessories. *Aviation*, December, 1945, pages 115–118, 7 illus.

Top Overhaul. Part I. Harvey A. Senior. Part I of a continued article on aircraft-engine overhaul considers disassembly and service. The writer supplies information about the protection of exposed parts, the removal of valves and rocker assemblies, the checking of cylinder barrels, the care of piston assemblies, etc. *Aviation Service Magazine*, November-December, 1945, pages 10–13, 20, 21, 37, 10 illus.

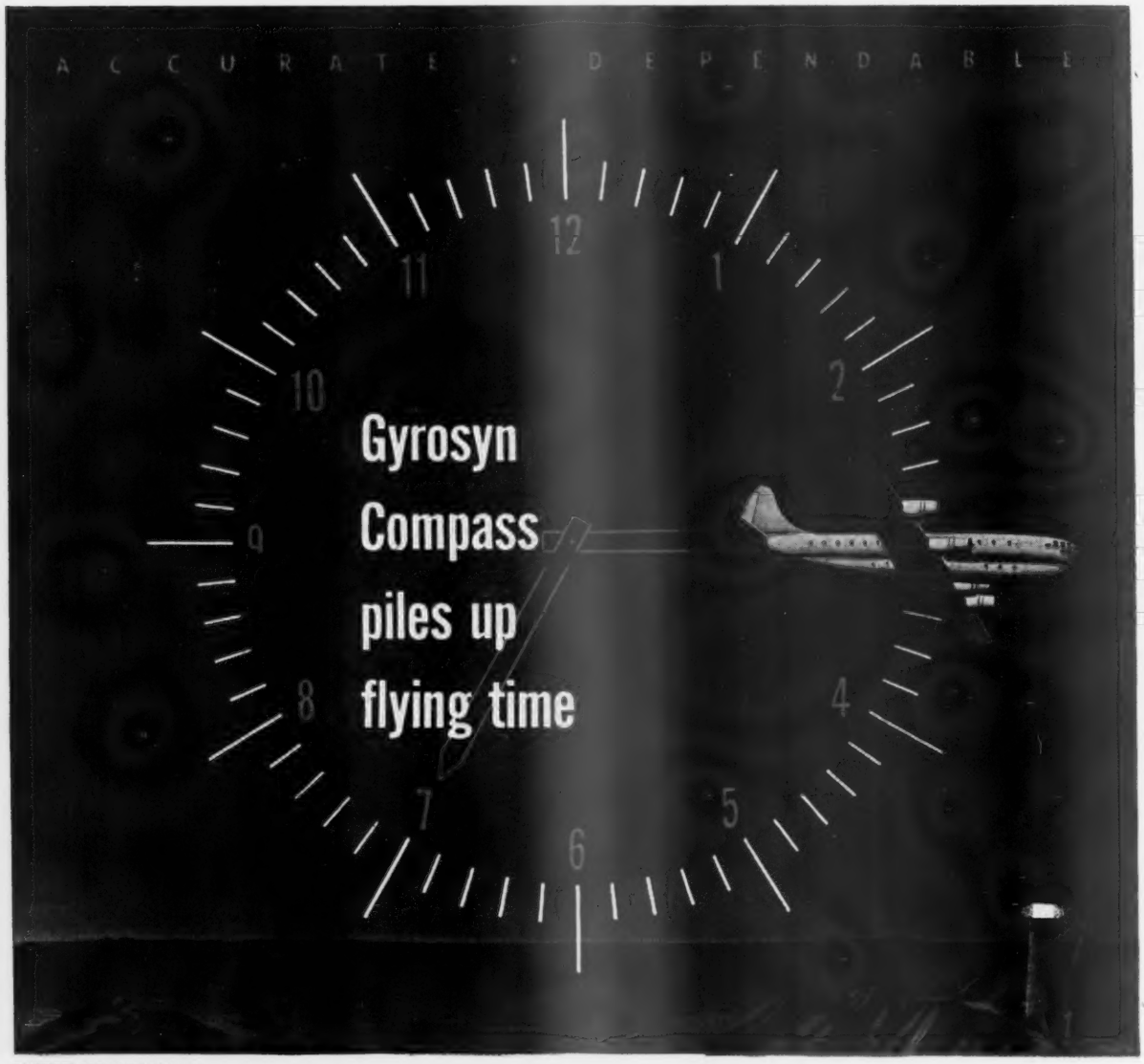
Make Those Minor Details Pay Off in Speed and Range. Major Thomas H. Bonser. Techniques of keeping airplanes aerodynamically clean and eliminating bumps, projections, dents, and roughness of finish so as to present the least possible resistance or drag, are reported. Aerodynamically undesirable conditions that may develop in various parts of the airplane are indicated; "don'ts" to be observed for efficient aerodynamic maintenance are listed; and methods of overcoming the undesirable conditions are recommended. *Aviation*, December, 1945, pages 119–121, 12 illus.

Check the Plane and You Check the Costs. Harvey A. Senior. Routines are advised for the daily and preflight inspection of personal aircraft. The inspection methods suggested pertain to the propeller, cowling, landing gear, wings, control surfaces, fuselage, cabin, engine, and other parts of light planes. *Aviation*, December, 1945, pages 122–124, 7 illus.

Integral Fuel Tank Repair. Harry E. Teasdall. Problems involved in sealing integral fuel tanks for aircraft are discussed. Experiments with various sealing materials are described. Particular reference is made to difficulties encountered in fuel-tank corners. Details are given about an injection system of fuel-tank repair using Thiokol as the sealant, which is stated to have been found successful in preventing leaks. *Aviation Maintenance*, December, 1945, pages 48, 111, 112.

ATSC Maintenance Never Halts Despite Its Reconversion. As exemplified by operations at Olmstead Field, Middletown, Pa., maintenance methods and problems of the Air Technical Service Command during the reconversion period are surveyed. Emphasis is placed upon the fact that the described program of maintaining military aircraft and engines is conducted under conditions whereby current work is carried on according to normal standards while reconversion changes are being made which affect every department of the maintenance organization. As related, three separate phases mark the changeover: (1) Provision must be made for service and overhaul of all types of A.A.F. aircraft in place of the former specialization which limited the operation to certain airplane types. (2) Smaller peacetime volume of work requires reducing or combining many departments with as little disruption of routine work as possible. (3) A large amount of heavy equipment must be moved, in some instances for a distance of several miles. *Aviation*, December, 1945, pages 125–127, 10 illus.

Maintenance System Mainsprings Pick-Up Line's Efficiency. Edward E. Thorp. A description of the system used by All American Aviation, Inc., for recording the time when each part of its different airplanes is due to be overhauled. This system is the means of keeping track of flight time; notifying foremen and others of impending work, thus preventing overload; noting replacements on hand and



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those required; providing a concise history of work done on every item that passes through the overhaul shops. Its basis is a standard card index, known as a parts-time tablet, which is used as a master record of the plane's flight time.

A floor plan of the hangar, office, shops, and equipment of All American Aviation, Inc., at Allegheny County Airport, Pittsburgh, supplements the article. Illustrations depict the forms used in the parts-time checking system. *Aviation*, December, 1945, pages 128–130, 5 illus.

NATS Cuts a Pattern for DC-4 Maintenance. Comdr. E. L. Ryder and Scholer Bangs. Two writers contribute to this article on methods used by the Naval Air Transport Service to maintain and service DC-4 aircraft. Comdr. E. L. Ryder outlines the overall maintenance picture. He discusses major overhaul and repair, or heavy maintenance, and keeping aircraft serviced between heavy maintenance periods. Scholer Bangs describes how maintenance work of the N.A.T.S. is detailed on sheets and cards. *Air Transport*, December, 1945, pages 34–41, 19 illus.

Take Care of Those Airplane "Eyes." James J. Rodgers and Norman Harlan. Techniques of caring for and repairing acrylic plastic transparent parts of aircraft are described. Differentiating between the three main types of plastics used for transparent enclosures in airplanes, the writers tell how to identify the material to be repaired or replaced, by burning, visual-inspection, and flexing tests. Advice is offered with regard to storing acrylic plastics; counteracting the detrimental effects of incorrect storage upon the plastics; proper cements to use and how to use them; removal of blemishes, grease, and oil from the transparent components; proper methods of polishing, buffing, sanding, "ashing," waxing; and materials to use for the finishing operations.

Procedures are outlined for the emergency repair of holes and cracks in the plastic parts, with attention given to the specialized routines for curved sections. A list of aircraft-plastics servicing materials, and the names and addresses of their manufacturers, is appended to the article. The list includes buffing compounds, polishes, and waxes. *Aviation*, December, 1945, pages 131–133, 255, 256, 259, 6 illus.

Whipping Corrosion Before It Starts. Paul Battilana. Specific precautionary measures are advocated for protecting seaplanes and floats from salt-water corrosion. The procedures and equipment fall under classifications of special treatment of components before the aircraft is ready for operation or before it is installed on its floats; daily maintenance; refinishing floats; launching and beaching. Detailed instructions are given for various maintenance operations. Credit for helping to overcome the harmful effects of salt-water corrosion is given to such factors as the development of

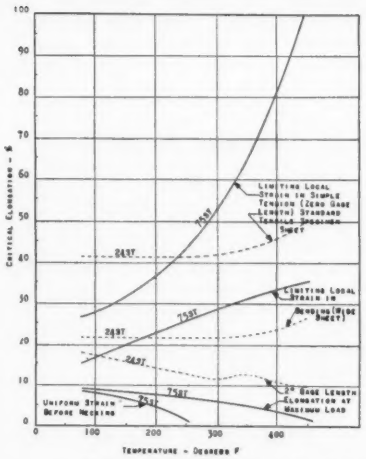

Illustration Courtesy Northrop Aircraft, Inc.

Effect of temperature upon critical elongation of 75S Alclad.

Alclad, metallizing of metal parts, waterproofing compounds, and stainless steel cables. *Aviation*, December, 1945, pages 134–136, 252, 253, 7 illus.

Marketing

Open Home Sales School for Dealers-Distributors. K. H. Holmgren. Details are supplied about a correspondence course that offers home training for aviation sales work, which has been developed by the Aviation Institute of Professional Sales Training. The course is reported to have been adopted by three light-plane manufacturers. Composed of 24 weekly lessons, it calls for salesman participation through solution of problems involving principles outlined in the textbooks. The course incorporates three major divisions: preplanning the sales interview; dramatizing the interview; and developing sales personality. *Aviation*, December, 1945, pages 176, 177, 1 illus.

Empire Requirements. By "Flapjack." With particular reference to the Australian civil-aircraft market, British aircraft manufacturers are advised of desirable design characteristics and standards that would increase the sale of their products to the Dominions. It is stated that in the past Britons have lost a substantial part of the Australian business to American airplane manufacturers because they have not provided for operating conditions in Australia. The geography and economics of Australia are described, and a brief account is given of the history, operations, and equipment of Australian National Airways.

British aircraft that are recommended as particularly suitable for the Australian market, with certain modifications, are the de Havilland Dove, Vickers Viking, Bristol Freighter, Miles Aerovan, Avro Tudor, and Handley Page Hermes. Other requirements cited for the Australian market are a multi-engined freight aircraft carrying 15,000 to 20,000 lbs. at a cruising speed of 160 to 200 m.p.h., tropicalization of power plants, and a light plane of stated specifications. *Flight*, November 20, 1945, pages 579, 580, 6 illus.

Materials

Chills for Light Alloys Castings. A. E. Cartwright. Particulars are given about the use of aluminum as a chill material for light alloy castings. It is stated that, despite its low melting point, aluminum is a safe and effective chill material because of its high specific heat, latent heat of fusion, and thermal conductivity. Tests conducted to determine the relative effects of different chill materials are described. *Aluminum and Magnesium*, December, 1945, pages 23, 24, 38, 2 illus.

8th Wonder? The application of magnesium to aircraft construction is considered. Properties, characteristics, and advantages of the material are described; its development for use by the aircraft industry is traced; and the fabricating methods and conditions by which it is employed are noted. Aircraft items made of magnesium are listed in groups of nonstructural parts, secondary structural parts, and primary structural components. *Air News*, December, 1945, pages 58–60, 85, 86, 5 illus.

Heat Treating, Forming and Welding 75S Alclad. Parts I and II. Mitchell Raskin. A two-part article reports some experiences of Northrop Aircraft, Inc., with 75S Alclad, which is relatively new among the light-metal alloys and is said to be the closest approach yet to a light alloy with the strength of heat-treatable steel.

In Part I the writer discusses the metallurgy, corrosion resistance, and strength of the material, and gives information regarding the treatment necessary to develop maximum physical properties. The structural properties of 75ST Alclad and other high-strength aluminum alloys are listed in a table.

In Part II information is supplied about the precautions to be observed in forming and spot welding 75S Alclad. A method of hot dimpling also is described. Figures giving data about bend radiuses and maximum allowable depth of scratch are tabulated. *The Iron Age*, December 6, 1945, pages 66–71, 5 illus.; December 13, 1945, pages 59–63, 5 illus.

What to Expect of High Strength Aluminum Alloys. Roy A. Miller and Max E. Tatman. Information is supplied about superaluminum alloys that have been made available during the past 2 years. Suggestions are made with regard to combinations of these high-strength alloys that will be practical from a production standpoint and also provide the best strength-weight ratios for airplane structures. Consideration is given to five groups of alloys now available in commercial quantities, consisting of those containing copper as the major alloying con-

stituent, which include T8 tempers of 24S alloy, R301, and 14S; and those containing zinc as the chief alloying element, which include 75S and R303 alloy. The characteristics of these alloys are listed, compared, and evaluated. *Automotive and Aviation Industries*, December 15, 1945, pages 18–21, 85, 86, 88, 3 illus.

Glycerine as Used in Aviation. Georgia Leffingwell and Milton A. Lesser. In this study of the uses of glycerine for aircraft applications the characteristics and properties of glycerine are discussed and their desirability for incorporation into materials for various types of aircraft needs is analyzed. The principal applications reviewed pertain to the use of glycerine in paints, varnishes, lacquers, enamels, and other protective coatings for airplanes and components. Numerous references are given to substantiate the statements. *Aero Digest*, December 1, 1945, pages 97, 169, 171, 2 illus.

Medicine

Delayed Combat Reactions in Air Force Personnel. Major Charles W. Miller, Jr. The writer discusses psychoneurotic reactions to combat experiences which were observed to develop in Air Forces personnel after passing through the screening processes incident to evacuation, redistribution, and assignment. Consideration is given to the various ways in which the reactions may manifest themselves, and to the manner in which they seem to be fostered and in which they may be reduced in incidence. *War Medicine*, October, 1945, pages 253–257.

Military Aviation

Why Jap Air Force Died. Philip Gustafson. Factors that caused the Japanese to lose control of the sky, as revealed by U.S. intelligence services, are described. It is shown that these included errors, delays, and omissions in design, development, production, and pilot training. *Popular Science*, January, 1946, pages 88–91, 214, 218, 11 illus.

Paints and Coatings

Surface-Conversion Coatings. George W. Jernstedt. Consideration is given to processes for chemically modifying metallic surfaces in order to secure greater resistance to high humidity, corrosive atmosphere, and high temperature. A considerable part of the article is concerned with surface-conversion coatings for aluminum and magnesium. Typical procedures for the anodic oxidation of aluminum are listed and comments are made about them. A new process for the treatment of magnesium, developed by the Consolidated Vultee Aircraft Corporation, is described. A table gives the characteristics of surface-conversion coatings for iron and steel, copper and brass, aluminum, magnesium, and zinc. *ASTM Bulletin*, December, 1945, pages 29–35, 9 illus.

Hard Chromium Plating Directly on Carbon and Graphite. Robert S. Herwig. A technique for direct plating on carbon, developed by the Bendix Aviation Corporation, is described. The method was developed to increase the fatigue life and other physical characteristics of certain parts without destroying the electrical properties. Chromium-plated-carbon brushes and other parts are cited as examples of the process. *Materials & Methods*, December, 1945, pages 1751–1753, 3 illus.

Throwing Power of Anodizing Baths. Robert S. Herwig and Albert Leigh. The article describes a device for visually determining the corrosion protection offered by anodizing baths, especially in the case of "blind" holes and crevices. This device, which is known as the Blum and Hogaboom type of box, also can be applied to the measurement of the throwing power of plating baths. The throwing power of a bath is defined as that property which is measured by the uniformity of the plating received by an object having recesses and cavities of varying shapes and depths. Reference is made to the difficulty of providing a more precise definition of the concept so as to permit

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its easy measurement. *The Iron Age*, December 20, 1945, pages 51–53, 4 illus.

Corrosion Protection for Flying Boats. Joseph J. Hendron. An evaluation is made of the various types of protective measures that have been tried at the Miami chemical laboratories of Pan American World Airways, where anticorrosion products for seaplanes are tested. It is explained that, while service testing on the airplane constitutes the final criterion of a corrosion protecting or inhibiting coating, such testing is principally of value in determining relative merits of different types of materials rather than evaluation of competitive products of the same type. This is because of the time factor involved, as well as the expense. For this reason the preliminary evaluation of anticorrosion products is made in the laboratory.

The corrosion protection of both external and internal surfaces of seaplanes is discussed. *Aviation Maintenance*, December, 1945, pages 44, 45, 120, 122, 124, 125, 5 illus.

Parachutes

Don't Count Ten! A parachute engineer warns fliers who have to bail out of aircraft to pull the ripcord immediately and not to wait for the counting of the proverbial "ten." He explains the reasons for this and also outlines a definite procedure for bailing out. *Skyways*, January, 1946, pages 50, 51, 92, 6 illus.

Personalities

Gallery of Aviation's Frontiersmen. John Hettich. An introductory article to a series reviewing the pioneers of aviation and their exploits. This installment merely lists the names of the subjects of the subsequent articles. Among the names mentioned are Wilbur and Orville Wright, John Montgomery, Thomas S. Baldwin, Octave Chanute, Thomas E. Selfridge, Frank S. Lahm, Glenn H. Curtiss, Glenn L. Martin, Hillery Beachey, Frank P. Lahm, Dr. William Green, E. L. Mathewson, Earle Ovington, Robert Fowler, Mathilde Moisant, and Lewis E. Goodier, Jr. *Aero Digest*, December 15, 1945, pages 40, 121.

The Winner of the Collier Trophy. Frederick R. Neely. Brief biographic notes about General Carl A. Spaatz are given in this article, which stresses his faith in air power and his record of championing a strong air force for America. *Collier's*, December 22, 1945, pages 24, 80, 1 illus.

A. N. Tupolev. A short sketch of the life of Major Gen. Andrei N. Tupolev, who took an active part in the organization of the laboratories at the Central Aero-Hydrodynamic Institute in Moscow. He has designed about 60 types of airplanes, twelve of which have been put into quantity production. Among his designs are the aircraft "Land of the Soviets," flown by Shestakov from Moscow to New York in 1929; the 8-engined "Maxim Gorky"; the ANT-25, in which type long-distance records over the North Pole from Moscow to the United States were established by Chkalov and Gromov in 1937; and current military airplanes. *Tekhnika Vozdushnogo Flota*, May, 1945, pages 26–29, 7 illus.

Personnel

Civilian Jobs for Airmen. Phillips J. Peck. In relation to 35 military specialties of the air forces, 300 civilian occupations are listed for which men trained in these specialties can qualify. The occupations include both aviation and nonaviation civilian jobs.

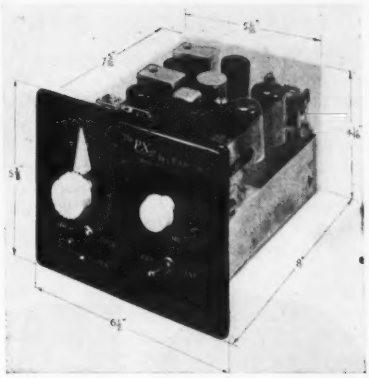
In addition, the article discusses provisions of the G.I. Bill of Rights which will help returning soldiers get additional training to fit them for civilian jobs. *Flying*, January, 1946, pages 23–25, 116, 118.

Plastics and Plywood

A Flying Fuel Tank. Particulars are given about the design and manufacture of the plastic fuel tank used in the Skycycle, new model in the Piper Aircraft Corporation line. It is explained that the front fuselage of this small personal aircraft is an adaptation of the jettison tank used throughout the war on the Corsair. These 189-gal. jettison tanks are made from a needled rope manila or sisal-fiber blanket impregnated with phenol-formaldehyde resin. Dry powder is vibrated into the mat to secure a resin content of 51 to 60 per cent. After the flat sheets are heated, they are placed over a metal mold, wrapped with cellophane, covered with a rubber blanket, and cured in an autoclave. *Modern Plastics*, December, 1945, pages 132, 133, 5 illus.

Four New Plastics in Use in Aviation. Thomas A. Dickinson. The properties, characteristics, and aeronautical applications of four new plastics are recorded. These are Plastipeel, Plastiform, Plastipaste, and Plastitool. Physical properties of each are charted. *Aero Digest*, December 1, 1945, pages 73, 74, 126, 4 illus.

Fabrication of High-Pressure Laminates. Richard M. Lane. Part I of a two-part article prepared to make clear the logical relationship existing between the structure and certain properties of high-pressure laminates and the most efficient fabricating procedure determined by them. The writer describes the properties of high-pressure laminates and shows in a general way how singly or in combination they affect fabricating procedure.



Phantom view of the Lear PX'er radio for private airplanes, showing the interior arrangement and exterior dimensions.

The properties of high-pressure laminates are compared with metals. The resilience, heat-transmitting properties, and strength of the laminates are discussed. *Modern Plastics*, December, 1945, pages 146–148, 6 illus.

Cellular Plastics in Aircraft. Carrol C. Sachs. Reference is made to the advantages of the method of stabilizing the skins of airplanes against compression buckling through the adhesive attachment of a supporting core of rigid cellular plastic of low specific gravity. Production techniques used in the manufacture of cellular boards are described in sections dealing with thermoplastic foams, thermosetting foams, and copolymer foams. The physical properties of cellular materials are discussed and consideration is given to the use of cellular boards in sandwich construction. Tables give physical data on experimentally available cellular boards, and a production scheme for rigid plastic cellular materials.

It is concluded that the use of cellular boards as core material for sandwich construction should result in saving of weight and in fabrication simplicity. *Modern Plastics*, December, 1945, pages 173–176, 1 illus.

Private Flying

Tips for the Personal Plane Buyer. Willis L. Nye. Prospective purchasers of personal airplanes are advised about definite items to be investigated in the selection of an aircraft. Selection factors are classified under three major categories: (1) initial cost, maintenance, service, and depreciation; (2) comfort and luxury; (3) technical details and structural design. Among the specific features and important assemblies indicated as requiring checking are the plane's type of construction, engine compartment, instruments, vision range, control surfaces, electrical system, wings, landing gear, and cockpit. *Aero Digest*, December 15, 1945, pages 50, 51, 128, 131, 132, 1 illus.

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Production

Production Planning. D. Tiranti. The purposes and functions of production planning are investigated. After submitting various interpretations of what is meant by production planning, the writer discusses its application to industry and its results in terms of manufacturing factors. He then gives his own definition of the process as follows: Production planning shall be that division of an industrial concern which shall be responsible for preparing all the necessary manufacturing data in order that the finished product shall be made correct to stipulated requirements. A bibliography and a flow chart showing the purpose of production planning supplement the text matter. *Aircraft Production*, December, 1945, pages 592–594, 1 illus.

Fabrication of Aircraft Fuel Tanks in Aluminum Alloy Containing 3% Magnesium. W. K. B. Marshall. Details are recorded about research and development work involved in the successful production of an aircraft fuel tank composed of aluminum alloy containing 3 per cent magnesium. The work was carried out with the object of designing a metal tank which in weight and performance would be equal to tanks made of magnesium-base alloys, but more suited to rapid production. Various stages in the solution of the problem are revealed in a description of the redesigning of a 50-gal. tank. *Transactions of the Institute of Welding*, November, 1945, pages 134–143, 20 illus.

Finishing Spur Gears for Aircraft Engines. Sidney Cornell. Reference is made to the important part gearing plays in the production of aircraft engines, contributing to their economical operation and light weight. The merits of both the grinding and shaving methods of finishing aircraft spur gears are reviewed. A description is given of the principles on which each process operates. *The Iron Age*, December 27, 1945, pages 46–50, 8 illus.; "Grinding Hardened Steel Precision Gears," by Emil A. Koether, *Materials & Methods*, December, 1945, pages 1754–1758, 3 illus.

Design and Production Technique. A. J. Schroeder. The fourth of a series on mechanical processes used in the production of aircraft parts explains the principles involved in drawing. Details are given about the forming of hollow components from plane material by means of a drawing die ring and a drawing punch, supplemented, when necessary, by the use of blank holders. Information is given about the way to ascertain the economically best method of working for a given number of pieces; the way drawing strains the material; and the construction (i.e., design plus production) of components. It is stated that great reductions in price can be reached by trifling modifications in the shaping of components and the method of drawing. *Aircraft Engineering*, November, 1945, pages 331–338, 75 illus.

Designing for Grinding Operations. Paul Dutter. The writer explains basic principles that must be understood in order to achieve the efficient production of aircraft parts requiring finish-machining. Descriptions are given of the operations under the headings of surface finish, cylindrical grinding, design considerations, surface grinding, and the grinding characteristics of materials. *Industrial Aviation*, December, 1945, pages 37, 38, 40, 65, 10 illus.

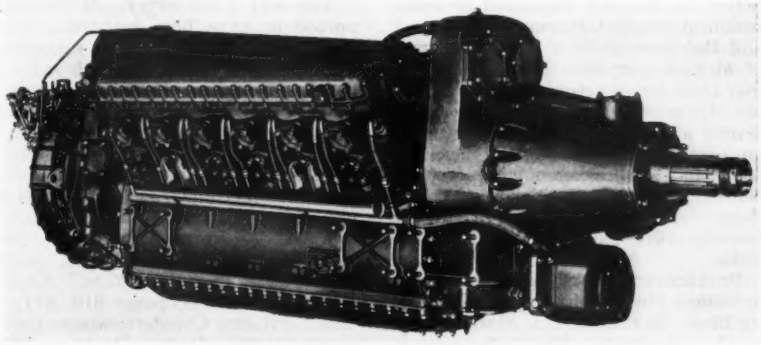
Modern Fabrication Practice. W. A. Roy and I. H. Hogg. The first part of this paper on various aspects of modern fabrication practice, with special reference to the emergency requirements of wartime conditions, applies to the aeronautical-engineering field. It deals with the production of engine mountings for Beaufighter and Lancaster aircraft. The writers describe how the Bristol Aeroplane Company developed an arc-welded tubular mounting. The object of designing the mounting for arc welding was to speed manufacture and reduce distortion effects. Information is given about the way the mounting was divided into subassemblies to facilitate welding operations, the use of the nibbling process to produce the correct profiles in the tube ends with more speed and less cost, and experimental work that was carried out. *Transactions of the Institute of Welding*, November, 1945, pages 144–150, 19 illus.

Processing of Magnesium Alloys. N. H. Simpson. The characteristics and processing of magnesium alloys are studied with particular reference to aircraft applications. The development of magnesium alloys that are resistant to corrosion is reviewed. Information is given about methods of transporting and storing magnesium alloys, to keep the metal in good condition during and after delivery and thus facilitate processing. Other sections of the article discuss blanking and shearing, forming, machining, joining, and welding magnesium alloys. *Aluminum and Magnesium*, December, 1945, pages 18–22, 36, 38, 11 illus.

Quality Control and Spot Welding. N. G. Dod. The application of statistical methods of quality control to spot welding is described and evaluated. Instructions are given with regard to obtaining the data for the quality-control charts, plotting the charts, and determining the results. It is concluded that the chief value of quality control when applied to spot welding lies in the extra knowledge gained about the process and the ability to detect promptly any deterioration which may have set in, coupled with a clear visual record of the "level" and stability of the process. Therefore, quality control for spot welding is recommended as an addition to, and not a substitute for, normal inspection routines associated with the process. *Aircraft Production*, December, 1945, pages 563, 564, 1 illus.

Forging Die Design. John Mueller. Particulars are given about hot working of small forgings on closed impression dies. As a typical example of this process, the forging of a crankshaft for a model airplane engine of the single-cylinder two-cycle type is described. The specifications of the engine, which has a piston displacement of 0.600 cu.in. and develops $^1/_8$ to $^1/_4$ hp., are listed. The operating sequence for forging the crankshaft is illustrated. The article explains how the dies were designed to control the metal grain flow to provide the strength necessary to withstand the stresses on the part under operating conditions. *Steel Processing*, December, 1945, pages 774–776, 4 illus.

Advantages of Double-Flared Tubing. Lucien Virgile. Merits of the double-flared tube for aircraft applications are indicated, with this type of tube claimed to be the most satisfactory means for correcting leakage in the oxygen systems of combat planes. The construction of the double-flared tube is described, its differences from the conventional single-flared tube are explained, and the results of tests conducted by the Air Technical Service Command to determine the efficiency of using double flares on tubing as-



The Continental liquid-cooled twelve-cylinder inverted V-type airplane engine is rated at 2,100 hp., develops 1 1/2 hp. per cu.in. of piston displacement, and weighs 0.78 lb. per hp. Its maximum diameter is 32 in.

semblies are reported. The article also contains information about how the flares are used and the best methods of applying them. *Aero Digest*, December 1, 1945, pages 89, 102, 2 illus.

Setup Charts for Bullard Mult-Au-Matics. John J. Meadows. Charts and instructions are supplied which are intended to enable the operator of Bullard Mult-au-matic screw machines to see at a glance the correct pair of change gears for each spindle speed and rate of feed. The charts are designed to save the setup man's time and reduce the risk of error involved when he has to make his own calculations. Particulars are given about the control of these automatic screw machines and the use of the charts. *The Iron Age*, December 13, 1945, pages 54–58, 9 illus.

Hawker Tempest. Part II. Wilfred E. Goff. The final half of a two-part article examining the processes and equipment with which the Sabre and Centaurus-powered versions of the Hawker Tempest are manufactured. Part II is concerned with the production of the wing subassemblies. It also details the final assembly of the complete component. Drawings and photographs illustrate various assemblies, manufacturing equipment, and production methods. *Aircraft Production*, December, 1945, pages 568–579, 38 illus.

Electropolishing of Metals. Charles L. Faust. The writer discusses the use of electropolishing as a means of solving a variety of production problems, including those in the aircraft industry. The article is confined to experience with a process using solutions developed by the writer and his associates, and covered by patents owned by the Battelle Development Corporation. The use of electropolishing as a deburring operation and in machining is described. *Industrial Aviation*, December, 1945, pages 20, 59–61, 3 illus.

Propellers

Propellers Are Gay Old Blades. Ken Lester. The nature, construction, operation and design requirements, and development of aircraft propellers are reviewed. Two propeller theories are explained in non-technical terms—the momentum theory and the blade-element theory. Types of aircraft propellers are noted; the four main forces acting upon propellers are discussed; and the products of several leading propeller manufacturers are described. In tracing the development and application of aircraft propellers, particular attention is given to those for light planes. *Air Facts*, January, 1946, pages 41, 44–48, 50–52, 5 illus.

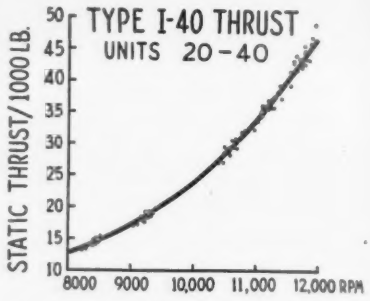
Profilirovanie Komplia Lopasti Vozdushnogo Vinta (Fairing of the Propeller Blade Shank). A. I. Slutskii and K. V. Zhustrin. Flight tests and calculations made by the Central Aero-Hydrodynamic Institute have shown that fairing of the blade shank produced a considerable increase in propeller efficiency. Wooden cuffs placed on the propeller of an airplane with a liquid-cooled engine increased the speed up to 5 km. per hour. Fairing of the propeller of an airplane with an air-cooled engine lowered the cylinder-head temperature as much as 20°C. The use of cuffs may also increase the ceiling of the airplane by increasing the pressure head in the air scoop. Principles of cuff design and constructional details are discussed, with a comparison of American, British, and Russian types. *Tekhnika Vozdushnogo Flota*, May, 1945, pages 1–5, 13 illus.

Radio

Radar Fundamentals for Engineers. The fundamental principles of radar are explained in this article, which is based on a report submitted to the Navy Department, Bureau of Ships, by the Westinghouse Research Laboratories. The article consists of a step-by-step description in easily understood language of the functions and operation of radar equipment, illustrated by diagrams. In the preliminary explanation the behavior of radar short-wave radio beams is compared with that of searchlight beams because both are beamed by a reflector and part of the radiation is reflected from an object and returns to the observer. Unlike light waves, reflected radar beams must be revealed to the observer by an indicator. It is noted that radar beams may be controlled more accurately than the searchlight beam, are effective over greater distances, and are not limited by atmospheric conditions. *Product Engineering*, December, 1945, pages 813–816, 15 illus.

Air Traffic Control. Part V. S. S. Stevens. The fifth in a series of six articles dealing with technical aspects of radio and communication in Canadian air transport. Explaining the importance of efficient air-traffic control systems, Part V describes the required characteristics of such a system. It is concluded that radio offers the only solution to a satisfactory and totally automatic airway traffic-control network. *Commercial Aviation*, November, 1945, pages 64, 101.

The War in the Ether. What is reported to have been hitherto secret information is revealed regarding radio countermeasures employed by the R.A.F. against German radar and radio communication systems. The nature of operations "tinsel," "window," "corona," "boozer," and "drumstick" are described. Data are given also about a radio countermeasure hoax that was successfully perpetrated in connection with the Normandy landing. *The Aeroplane*, December 7, 1945, pages 659, 660; "The Illusionists," *Flight*, December 6, 1945, pages 610, 611, 1 illus.; "Radar Countermeasure Techniques," *Aero Digest*, December 15, 1945, pages 49, 121, 1 illus.; "Radar Countermeasures," *The Engineer*, December 7, 1945, pages 460, 461.



Average static thrust of the General Electric type I-40 gas turbine.

Reaction Propulsion

The Gas Turbine in Aviation. S. R. Puffer and J. S. Alford. Advances in the design of gas turbines during the last 25 years are reviewed briefly. The future trend of gas-turbine developments is discussed. It is stated that the successful accomplishment of the earlier phases of gas-turbine work has provided a firm base from which to proceed to greater and more important developments. Consideration is given to the compounding of an internal-combustion engine with a gas turbine, the use of a gas turbine for straight jet propulsion, and its use for combined propeller and jet propulsion. The advantages of the gas turbine as a main power plant are enumerated.

As a means of showing relative standings of the different types of power plants, two comparisons are outlined. The first of these, shown in chart form, presents comparisons by weight and fuel economy, respectively, of various types of power-plant installation. In the second comparison, each type is assumed to be installed on a pursuit aircraft. The weight of the power plant, fuel, and the fuel tanks is kept constant in this comparison. Preliminary performance calculations for airplanes powered by jet propulsion units are supplied in an appendix. *Mechanical Engineering*, December, 1945, pages 803–812, 24 illus.

Jet-Driven Props May Power Personal Planes of the Future. Alexander McSurely. Information is given about tests that are being carried out with small propellers which obtain their driving force from the reaction produced by hot gases discharged from nozzles at the propeller tips. The tests are being conducted by engineers at the Cleveland engine-research laboratory of the N.A.C.A. It is stated that several arrangements of the jet propeller are being studied. One scheme provides for drawing air in at the propeller hub and compressing it by the centrifugal action during the air's passage out through the hollow blades toward the tips. Fuel is injected into small combustion chambers near the tips and the mixture is ignited. The rapidly expanding hot gases push out through the propeller-tip nozzles, which are set at a tangent to the blades.

Another more complex design uses a compressor at the propeller hub, to give a first compression to the air which is brought in from scoops in the leading edges of the plane's wings. The air is further compressed by the centrifugal action as it flows out through the blades.

A third arrangement would use small ram-jet engines at the propeller tips, with the compression obtained solely by the ram effect, and the combustion accomplished at the tips. *Aviation News*, December 24, 1945, pages 7, 8, 3 illus.

Research

Inquest on Chaos. Sir Roy Fedden. The first of three articles reporting on the findings and observations of a member of a British technical mission to Germany. As stated, the chief purposes of the mission were to (1) note suitable plant and research equipment for a new college of aeronautics to be set up at Cranfield, Bedfordshire; (2) investigate and report on certain aspects of power-plant development, especially the engineering and production approach on jet engines and their state of production potentiality at the time of Germany's collapse.

Among the writer's comments are remarks pertinent to German wind tunnels and other research equipment; the data they accumulated on problems of flight at sonic speeds; their methods of conducting research projects; the German policy of attempting large-scale production of jet propulsion units in face of the shortage of suitable materials; and Allied political problems with regard to the disposition of German scientific and research equipment. Some of these problems are summarized as involving questions of whether the equipment should continue to be operated in Germany by the Allies or transferred to Allied countries, and whether German scientists should be sent to England and America to work (as they have been to Russia) or be turned to some other occupation. It is the writer's opinion that they should be set to work for the Allies, but that, under adequate supervision, they should be permitted to work in their own country.

The article also includes brief comparisons of German research methods and equipment with those of Britain. *Flight*, November 29, 1945, pages 575–578, 8 illus.

German Piston-Engine Progress. Sir Roy Fedden. The second of three articles reporting on the findings and observations of a member of a British technical mission to Germany, this article is concerned with the writer's impressions of German piston-engine development at the time of that country's collapse and with prospects of future progress. Features of engine types manufactured by the three principal German engine firms—Daimler-Benz, Junkers, and B.M.W.—are reviewed. Remarks are made pertinent to the operating techniques of these companies, their problems, their rate of production, and the slowing up of their output because of Allied bombings. Projected departures from the inverted V-12 and two-bank radial models are noted, and attention is called to the fact that 5,000-hp. aircraft engines were being planned by German manufacturers. In addition, German piston-engine development is compared with that of the British. *Flight*, December 6, 1945, pages 602–606, 9 illus.

Photograph Courtesy Bell Aircraft Corporation

Rotor-mounting arrangement of Arthur M. Young's helicopter rotor.

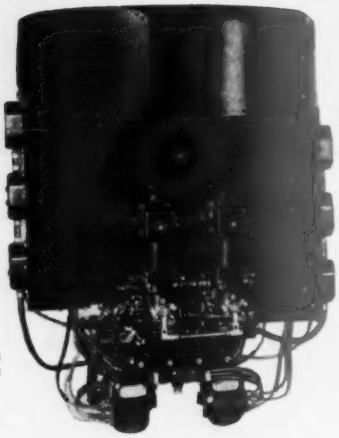
Role of Air Technical Intelligence in Defeat of the Luftwaffe. The functions and operating methods of the Air Technical Intelligence Section of the Air Technical Service Command are described. It is related how this division of the Army Air Forces collected items of German air equipment, shipped them to Wright Field, analyzed and evaluated them. Data are included about the qualifications and training of personnel for A.T.I. jobs, and the development of the group from a nucleus which first operated during the North African campaign. *Aero Digest*, December 1, 1945, pages 40, 122.

Rotating Wing Aircraft

Helicopter Stability with Young's Lifting Rotor. Bartram Kelley. The writer explains the nature of the instability of helicopters and describes factors that contribute to instability in this type of aircraft. Details are given about two early attempts to solve the instability problem which were made by Arthur M. Young. A device that is stated to make model helicopters perfectly stable in flight is described. Particulars are given about the application of this device to full-scale helicopters. *SAE Journal*, December, 1945, pages 685–690 (Transactions), 11 illus.

Design Aspects of the Kellett XR-8 Helicopter. Lancelot S. Gibson. The writer describes outstanding constructional features of the XR-8, developed and manufactured by the Kellett Aircraft Corporation. It is stated that the initial test flight of the XR-8 was completed on August 7, 1944, and since that time this aircraft has been involved in an extensive test program under the supervision of the Army Air Forces. To eliminate torque reaction, the principle of twin. counterrotating inter-

Strength is IN



A typical installation of an Air-Shields Harness on a Helicopter Engine.

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On every important point, Air-Shields harnesses have consistently demonstrated their superiority over ordinary types of shielding. If you have a shielding problem in airplane, automobile, marine or stationary gas engines, take advantage of Air-Shields expert engineering service.

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meshing rotors is utilized. Details are given about the transmission unit, which receives all the power except the loss to the cooling system and transmits it to the rotors. Important specifications of this helicopter are listed. The rotor head and control linkage are described. *Industrial Aviation*, December, 1945, pages 7, 8, 10, 5 illus.

The Helicopter Today. James G. Ray. A consideration of some of the problems involved in piloting a helicopter. These problems result from the unique ability of the helicopter to move in any direction. The controls necessary to meet this condition are analyzed. While great future possibilities are predicted for the helicopter, it is emphasized that at the present time the job of piloting a rotary wing aircraft is an intricate one, requiring knowledge and skill. *Flying*, January, 1946, pages 44, 45, 113, 114, 3 illus.

Analysis of Helicopter Drive Problems. Mario di Giovanni. The purpose of the article is to analyze the mechanical problems of the helicopter, to classify the various mechanical elements required in the rotor-driving mechanism, and to evaluate their functions. Equations are derived for calculating the speed of the rotor and the relationship between the weight of the helicopter and the angular velocity required of its rotor to support that weight at the best thrust coefficient. Another factor is the disc loading, or weight of the machine per square foot of the area swept by the rotor, in order that autorotation may provide a means of safe descent in the event of engine failure.

Attention is given to methods of power transmission, relative to the length and means of support of shafting, universal joints, location of the power plant and cooling of the engine. A formula is worked out for an approximate calculation of the weight and size of the flywheel necessary to allow for the speed fluctuations of the engine. Suggestions are made regarding the type of clutch to be used.

The eight mechanical elements required in a helicopter drive are listed, and the objectives of the designer are summarized as lighter and more efficient mechanisms. It is stated that mechanical efficiencies of better than 95 per cent (excluding power for cooling) and weights limited to 50 or 60 per cent of the weight of existing drive mechanisms are not unreasonable goals for designers to expect if the elements are specifically designed for the helicopter, and if sound engineering and precise machining are employed. *Aero Digest*, December 1, 1945, pages 58–60, 117, 3 illus.

Stress Analysis

Investigation of Three Methods for Solving the Flutter Equations and Their Relative Merits. R. J. Ruggiero. Three methods for solving the dynamical equations of flutter are presented. The application of these procedures to systems described by more than three degrees of freedom is discussed. It may be pointed out in this connection that the number of degrees of freedom is not always a true indication of the complexity of a problem. Problems are more legitimately compared when the dynamical equations are reduced to a standard "canonical" form.

The essential steps in the methods presented are illustrated with detailed numerical examples. Moreover, a knowledge of the mathematics required in the theory is not presumed. All such material is developed in a preliminary section of the paper.

Convenient formulas for solving the general cubic and quartic equations are given. The formulas have been found to be well suited to machine computation. A concise tabular process for solving a system of linear equations is explained, with a numerical example.

Practical suggestions, based on experience, are offered relative to the organization of flutter calculations. The results of an extended time study are presented, which compare the methods on the basis of computing man-hours required. This comparison is rounded out with a discussion of the relative merits of the methods with respect to other considerations that are not included in the time study. On the basis of these results definite recommendations concerning the use of the methods are made. *Journal of the Aeronautical Sciences*, January, 1946, pages 3–22.

A Simple Tabular Method of Calculating Deflections and Influence Coefficients of Beams. N. O. Myklestad. The present method of finding deflection curves and influence coefficients is easily applied to cantilever beams and to simple beams with or without overhangs. It is fast and accurate when a calculating machine is available, but slide rule accuracy is probably sufficient for most practical purposes. The method possesses the additional advantage that the calculations can be performed in a routine manner by a computer who knows nothing about beam theory. The method assumes that the beam itself is weightless and carries a finite number of concentrated forces. *Journal of the Aeronautical Sciences*, January, 1946, pages 23–28, 11 illus.

General Instability of Semimonocoque Structures Under Bending. Tsun Kuei Wang. Structural engineers are constantly faced with the difficulty of obtaining suitable formulas for the calculation of general instability of semimonocoque structures. The writer has written a series of papers in an effort to solve this problem. In this paper, a theory of buckling is presented in which an empirical correction is recommended. The theory takes into account the torsional rigidity of stringers and rings which other authors have not considered. The empirical correction introduced accounts for the effect of skin on the number of longitudinal buckling waves. Also, the formula as developed involves use of more of the geometric characteristics and section properties of the structure than have the formulas developed by other authors. It is found that the theoretical predictions as modified by the correction factors and the experimental results are in agreement with regard to wave pattern and buckling load. *Journal of the Aeronautical Sciences*, January, 1946, pages 29–37, 8 illus.

Secant Modulus Method for Determining Plate Instability Above the Proportional Limit. George Gerard. The classical plate instability equation is considered in terms of strain rather than stress. Upon the assumption that the critical stress and critical strain are implicitly related by the stress-strain curve of the material, it is found that the secant modulus can be used in the plate buckling equation to predict critical stress above the proportional limit. The assumption is confirmed by tests on aluminum alloy Z and channel sections. *Journal of the Aeronautical Sciences*, January, 1946, pages 38–44, 48, 10 illus.

Stress-Strain Formulas. William R. Osgood. Most of the analytical expressions for stress-strain curves that have appeared in contemporary publications and a few others are considered critically. It is concluded that six have general value, and, of these, two are to be preferred in seeking a fit to stress-strain data.

The number of formulas that could be devised is of course unlimited. Some day empirical formulas may be replaced by a theoretical formula. Meanwhile, it should be possible to fit almost any stress-strain data adequately by means of one of the formulas given in this paper. Although some formula with three parameters could be made to represent more stress-strain curves than any formula with two parameters, in general, the evaluation of three parameters for a best fit will be considerably more time-consuming than the evaluation of two, and a three-parameter formula will be much more cumbersome to apply in structural analysis than a two-parameter formula. It does not seem worth while therefore to seek increased generality by means of a third parameter. *Journal of the Aeronautical Sciences*, January, 1946, pages 45–48, 1 illus.

Experimental Verification of Cumulative Fatigue Damage. Milton A. Miner. Reference is made to factors that have retarded progress in fatigue analysis, which include lack of basic information about material behavior and lack of a basic method of handling any but the simplest problems. The principal part of the article is given to a means of evaluating the cumulative effects of cycles of stress at various stress levels. It is assumed that the phenomena of cumulative damage under

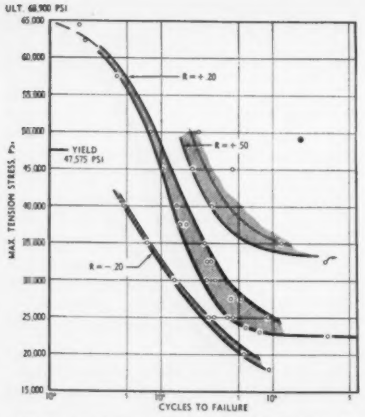

Illustration Courtesy Douglas Aircraft Company, Inc.

Curves representing the relationship of stress to number of cycles of application required to produce failure of specimens of Alclad 24S-T, at various ratios of minimum stress to maximum stress in a loading cycle.

repeated loads is related to the net work absorbed by a specimen; and that the number of loading cycles applied, expressed as a percentage of the number required to produce failure at a given stress level, is the proportion of useful life expended. When the total damage as defined by this concept reached 100 per cent, the fatigue specimen should fail. Experimental verification of this concept for an aluminum alloy using different types of specimens, various stress ratios, and various combinations of loading cycles is supplied. *Automotive and Aviation Industries*, December 1, 1945, pages 20–24, 56, 58, 12 illus.

Sandwich-Type Shear Panels of Wood-Aluminum Construction. H. Langhaar and R. Fefferman. Methods are described for the theoretical determination of the buckling stress in sandwich panels for aircraft, and the results of tests on beam webs composed of aluminum-alloy skin surfaces cemented to balsa cores are detailed. The method provides a means of estimating the strength of sandwich panels when the core and bond provide adequate coupling between the cover sheets. Tables give figures for material properties of web skins, and test results and comparative data. *Product Engineering*, December, 1945, pages 841–844, 5 illus.

Deflexion of Tapered Beams. R. Tatham and H. L. Price. In this investigation consideration is given to the deflection caused by bending of a tapered cantilever beam carrying concentrated end and lateral loads at the free tip. The mode of taper of the beam is assumed to be of a generalized form and is such that the second moment of the area of the cross section at any point varies as the *n*th power of its distance from the unsupported vertex. Detailed calculations are given for the cases corresponding to the type of beams most commonly arising in practice. It is shown that fairly substantial errors may arise if the commonly used approximate treatments are adopted. It is stated that the theory may also be extended to yield the value of the critical end loads for tapered struts conforming to any value of *n*. *Aircraft Engineering*, November, 1945, pages 312–316, 329, 4 illus.

Superchargers

Axial vs Centrifugal Superchargers for Aircraft Engines. W. J. King. After briefly reviewing the functions and requirements of an aircraft-engine supercharger, the writer compares the merits of the axial and radial types. The belief is expressed that interest in the axial-flow type will increase, partly because of the impetus recently given to the development of new designs for various kinds of gas turbines. It is stated that the trend toward higher critical altitude will provide further incentive to exploit the relatively high volumetric capacity of the axial design. In the final analysis, however, the writer feels that, within the next few years, the choice between the axial type and the centrifugal type of supercharger may be made more upon the basis of adaptability to particular installations than upon any intrinsic superiority of one over the other. Diagrams of supercharger design and performance characteristics are included. *SAE Journal*, December, 1945, pages 736–741, 748 (Transactions), 11 illus.

Testing

Buying Performance. H. R. Footitt. Improved test procedure is advocated to provide more accurate data on aircraft performance for prospective airplane buyers. In the case where a manufacturer is not equipped to supply an accurate flight-test performance report, it is recommended that a Government agency, such as the Civil Aeronautics Board, should be prepared to lend flight crews and equipment so it can issue an "approved performance report" along with the Approved Type Certificate. The need for such routine in order to offset performance variations which currently appear in published figures is illustrated by a comparison of four different airplane models with almost identical basic design characteristics. *Western Flying*, December, 1945, pages 46, 47, 76, 2 illus.

Testing Equipment

Weight Control. George H. Tweney. The accurate determination of weight as a factor in wind-tunnel and power tests, by means of specialized mechanical instrumentation, is discussed with particular reference to equipment designed by Dr. H. O. Hem, who has been engaged in weight instrumentation since 1889. Some of the many wind-tunnel and other measuring systems designed by Dr. Hem during the wartime period are described, including the installation at the Ames Aeronautical Laboratory, Moffet Field, Calif. *Industrial Aviation*, December, 1945, pages 30–32, 58, 5 illus.

Tools and Equipment

A New Light Conveyor. The construction, operation, and merits of the Teleflex overhead conveyer system are described. A continuously-operating type, the Teleflex system is noted for using standardized components throughout and eliminating the need for any extensive special design work in its installation. It embodies a flexible cable drive. The basis of the conveyer is a runway rail to each side of which is spot-welded and riveted a drawn, split-steel housing in the form of an almost-complete tube. Constructional details of the system are illustrated by drawings. *Aircraft Production*, December, 1945, pages 580, 581, 2 illus.

Bellcrank Production Boosted by Switching Weld Location. A report is made of the economies effected through the relocation of fillet welds. It is explained how the changing from fillet applications at tight inside corners of bell-crank assemblies to outside areas readily accessible to the arc welding rod resulted in elimination of production slowdown and afforded superior attachment strength of the parts. *Aviation*, December, 1945, page 197, 2 illus.

Metallizing as a Production Process. Reference is made to the increased importance now attached to metallizing as a result of experience with this process in war-production applications, including the aluminum spraying of aircraft-engine cylinder fins. Information is given about improvements in metallurgic equipment to permit 24-hour operation. A new production type of spray gun is described and illustrated. *The Iron Age*, December 13, 1945, pages 72, 73, 3 illus.

All-Purpose Workstand for Aircraft. The design, construction, and use of a large Aerostand developed by Pacific Engineering Corporation to meet Lockheed specifications for production work on final assembly of the C-69 Constellation, are described. The workstand is 39½ ft. long and is made of welded, lightweight high-carbon steel tubing. It is divided into four sections to allow room for the plane's landing gear to pass between sections. Each set of two stands is operated by a two-cylinder hydraulic pump to raise it from the collapsed position to a height of 11 ft. 8 in., or any desired height within that limit. A release valve is actuated to lower the stand. *Aero Digest*, December 15, 1945, page 70, 1 illus.

Cylindrical Draughting Machine. A brief description is given of the construction and application of a cylindric drafting machine adopted by Metropolitan-Vickers Electrical Company, Ltd., for the preparation of layout drawings and diagrams. This machine makes use of the principle that, since the lines of these drawings and diagrams are, in general, horizontal and vertical ones, with circular or rectangular symbols, it is possible to draw the lines on the outer surface of a cylinder. Advantages claimed for the new type of drawing board are that the working

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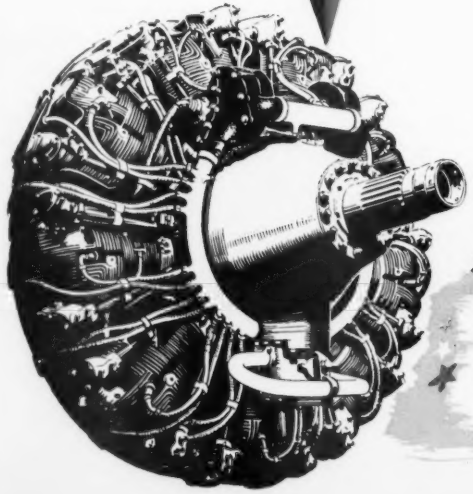

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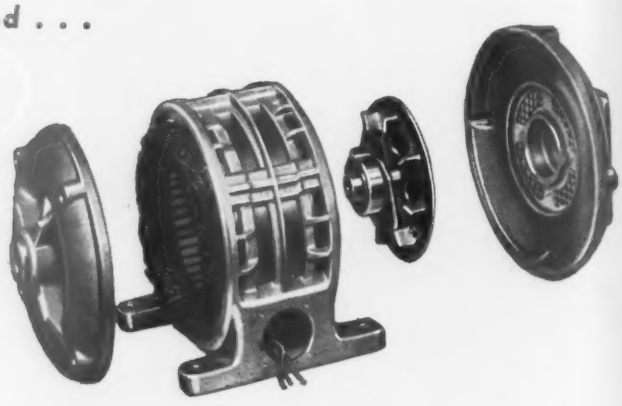
grey iron: 21 lbs.

magnesium: 5.1 lbs.



A switch in materials brought about this *75% cut in weight!* It was a job magnesium took in stride—lightening a 5 h.p. electric motor for aircraft use.

One group of parts—motor housing, bearing brackets, fans—weighed 21 pounds in cast grey iron. Magnesium sand castings brought that weight down to 5.1 pounds . . . a saving of 15.9 pounds! Rigid tests and extensive use proved the application a complete success—another of magnesium's many achievements in aircraft.

Designers and manufacturers in the aircraft industry have made great strides in magnesium application, and many other industries are following suit with equal success. Dow engineers, available through the nearest Dow office, offer valuable technical aid in the use of this lightest structural metal.

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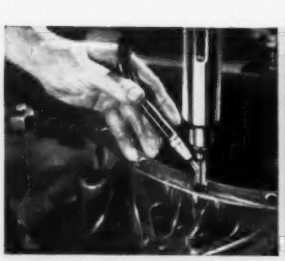
MAGNESIUM

LIGHTEST OF ALL STRUCTURAL METALS



This tapping operation on a radial aircraft engine is one of the standard procedures for machining magnesium.

Magnesium aircraft applications include many such units as this oil tank, its parts being joined by gas welding.

Uniformity is maintained by close attention to such details as the inspection of these cast magnesium aircraft wheels.

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point of the cylinder is at a relatively constant distance from the eye, and the illumination of the surface is also relatively uniform. *Aircraft Production*, December, 1945, page 567, 1 illus.

How to Install an Air Compressor. Lee J. Bregenzer. Reference is made to the increased importance attached to air-compressor equipment in the air-lines' repair base, because of the rapid development of pneumatic tools and the many new uses found for compressed air in the repair shop. Information is supplied about sizes and types of compressors to fulfill various requirements. The layout and installation of air-compressor equipment is described. *Aviation Maintenance*, December, 1945, pages 49–51, 98, 100, 102, 104, 2 illus.

Training

Close Support. The course of instruction given at the School of Air Support, where R.A.F., Army, and Navy officers are schooled in the use of aircraft in close support work, is described. Developed from the School of Army Cooperation, the objective of the School of Air Support is to teach a common doctrine in air support while holding courses of instruction for all three services; study all matters affecting the air support of armies; maintain close liaison with its counterpart at home and overseas and with commands at home and overseas; keep up to date with current developments in air support. Information is given with regard to the school's organizational setup, executive and teaching personnel, equipment, and operating methods. *The Aeroplane*, November 16, 1945, pages 564, 565, 6 illus.; "The School of Air Support," by Major F. A. de V. Robertson, *Flight*, November 22, 1945, pages 554a–555, 4 illus.

Handling the Knobs and Taps. J. A. V. Watson. Noting the complexity of the controls in the modern aircraft, an account is given of the methods taught to ferry pilots of Air Transport Auxiliary to enable them to step into two or three different cockpits each day and yet handle the aircraft with safety. *Aeronautics*, December, 1945, pages 83, 84.

Eggbeater's Stepchild. Ed. Burke and N. DuBeau. An indoor "flying" device for training helicopter pilots is described. Installed at the Coast Guard Air Station, Floyd Bennett Field, N.Y., and based on sketches drawn up by the Special Devices Division of the Navy's Bureau of Aeronautics, the innovation is reported to simulate in virtually every aspect the operation and flight conditions of the Sikorsky HNS-1 helicopter. It is known as Helicopter Trainer Device RF-2. *Skyways*, January, 1946, pages 30, 31, 78, 4 illus.

Sports Aeriens. Corp. Albert L. Lewis. French North Africa's air-age education program is outlined. Organized under the name of Delegation des Sports Aeriens during the Vichy regime, it is related how the program is being continued now that France has been liberated. Model building, class work, gliding, and powerplane flying phases of the program are described. Information is given regarding organizational setup, equipment and facilities, eligibility requirements for trainees, instructional staff, and method of defraying costs. *Air Trails*, January, 1946, pages 26, 27, 98, 100, 102, 6 illus.

Welding

Gas-Shielded Arc Welding of Aluminum. A. F. Leach. Details are given about the new gas-shielded arc-welding process, used in fabrication of aluminum parts for aircraft and other purposes. It is noted that the process actually encompasses three different methods of welding, which are discussed in sections given to atomic-hydrogen arc welding of aluminum, helium-shielded arc welding of aluminum, and argon-shielded arc welding of aluminum. In conclusion, the advantages of the gas-shielded process are summarized. *The Welding Journal*, December, 1945, pages 1129–1134, 8 illus.

The Welding of Non-Ferrous Metals. Part VII (Continued). E. G. West. Gas and metallic arc welding of aluminum and its alloys is the subject of the current installment of an article on nonferrous metal welding. Gas welding is treated in sections dealing with flame conditions, filler rods, fluxing, preheating, and welding procedure. Information then is supplied about metallic arc welding, which, it is noted, is a process that has been developed only recently for aluminum and its alloys, chiefly because of the inherently unstable nature of arcs between aluminum electrodes. Preparations and procedures for metallic arc welding are set forth. *Sheet Metal Industries*, December, 1945, pages 2167–2174, 13 illus.

An Investigation of the Spot Welding of Aluminum Alloys Using Magnetic Energy Storage Equipment Provided by the Sciaky Brothers. W. F. Hess, R. A. Wyant, and B. L. Averbach. A report on part of a program providing for a comparative study of three different types of welding equipment offered for the spot welding of aluminum alloys for aircraft. It describes the experience and results obtained with the magnetic energy-storage equipment provided by the firm of Sciaky Brothers. Details are given about the equipment and the characteristics of the welds made with it. The results obtained are summarized. *The Welding Journal*, December, 1945, pages 629-s–643-s, 22 illus.

Pressure Welding of Light Alloys Without Fusion. R. F. Tylecote. This report describes the results of attempts to weld overlapping sheets of nine aluminum and three magnesium alloys by the simultaneous application of heat and pressure at temperatures below their melting points. It was found possible to weld all the alloys to a greater or lesser degree. An aluminum alloy containing magnesium and silicon in the proportions to give Mg_2Si, a duralumin type alloy, and an aluminum alloy containing $1^1/_4$ per cent manganese, were found to give the best results. Great importance is attached to the effective cleaning of the surfaces. Although recrystallization occurred across the interface in many cases, it is stated that the microscopically visible recrystallization cannot be established as a necessary condition for successful welding. *Transactions of the Institute of Welding*, November, 1945, pages 163–178, 41 illus.

Spot Welding of Heavier Gages of Aluminum Alloy. R. C. McMaster and N. A. Begovich. Two related articles concern the processes of spot welding aluminum alloys. The first report gives details regarding the design, construction, calibration, and method of using a new portable instrument for measuring welding current and tip force in spot-welding machines. Current and tip force are measured by means of a small unit combining a toroid and a strain-gage bridge. The unit may be slipped over the electrode holder of any spot welder and clamped ready for use in a few minutes. It is explained that the simultaneous records of welding current and tip force obtained with the unit may be applied to either a cathode-ray or magnetic oscillograph or both. With a long persistence tube in the cathode-ray oscilloscope, the welder performance may be checked visually. The magnitude of welding current, the tip force, and the timing may be measured directly from the screen of the cathode-ray oscillograph. Permanent records can be obtained at low cost by photographing the cathode-ray tube screen with a 35-mm. camera. It is stated that the new instrumentation should have an immediate, wide application in the aircraft industry where new specifications require frequent oscillographic checking of welder performance in spot-weld production.

The second report is titled "The Spot Welding of Wire-Brushed 24S-T Alclad Aluminum Alloy Sheets in Thicknesses from 0.081 to 0.125 In., Inclusive." It summarizes the results of a study of the technique of spot welding 24S-T Alclad aluminum-alloy sheets of 0.081, 0.091, 0.102, and 0.125-in. thickness. The investigation was carried out with a press-type condenser-discharge aluminum spot welder with a given maximum capacitance and a maximum tip force of 9,000 lbs. Curves and data are presented to show the influence of welding-machine variables upon weld strength, geometry, and quality. Opti-

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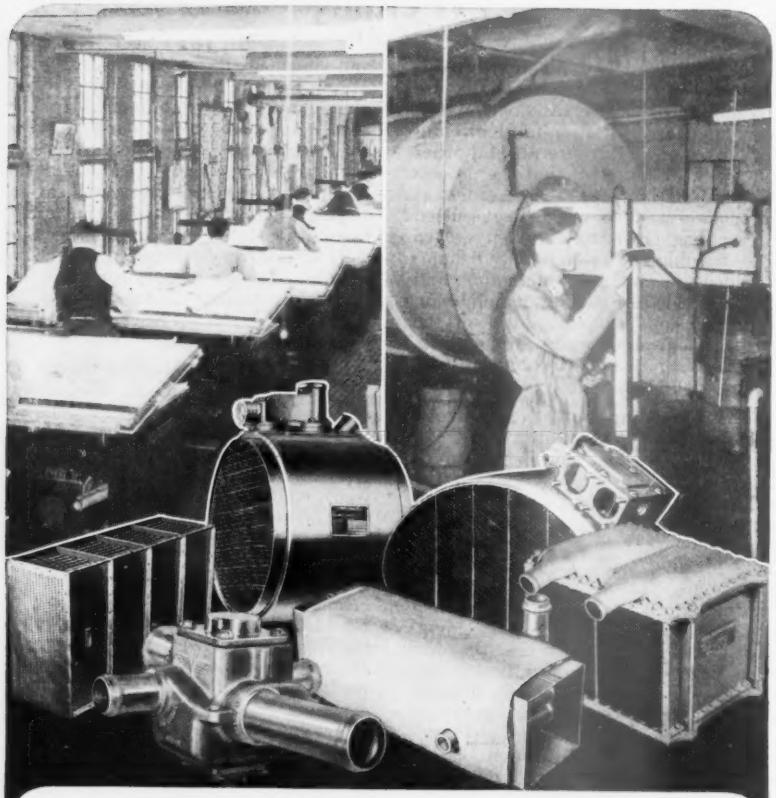

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mum welding techniques are indicated for the listed gages. *The Welding Journal*, December, 1945, pages 644-s–666-s, 45 illus.

Copper Furnace Brazing. Glen A. Robinson. The subject of copper furnace brazing is discussed in the light of experience gained in the aviation industry. The information is based on a series of investigations carried out at plants of North American Aviation, Inc. The four principal phases dealt with are the application of furnace brazing and the results obtained; furnace-brazing equipment; furnace-brazing technique; and the strength of brazed joints. Conclusions drawn from the investigation are: (1) Because of the simplicity with which complicated parts can be assembled and fabricated, it is certain that furnace brazing will be extensively used in the future. (2) Furnace-brazing equipment requires accurate time, temperature, and atmospheric controls. (3) Ample strength and a high percentage of completely bonded joints are the result of the present furnace operations. *Machinery*, December, 1945, pages 139–146, 5 illus.

The Spot Welding of Dissimilar Thicknesses of Alclad 24S-T. W. F. Hess, R. A. Wyant, and B. L. Averbach. The investigation reported, which was part of the work conducted in connection with an aircraft spot-welding research program, was limited to the welding of 0.020 to 0.040, 0.020 to 0.064, and 0.020 to 0.125-in. Alclad 24S-T. Consideration was given to methods of leaving either the thick or the thin sheet smooth. The relative effect of each of the following factors in determining the location of the zone of fusion were evaluated: (1) the shape and size of each electrode; (2) the conductivity of each electrode; (3) the contact resistance at the faying surfaces. Conclusions reached from the investigation are enumerated. *The Welding Journal*, December, 1945, pages 667-s–672-s, 3 illus.

The Aluminum Dip Brazing Process. C. L. Bensen and R. N. Weber. The technique of bonding together two or more surfaces of aluminum in a molten bath of brazing flux is discussed. The article is based on the experience of McQuay, Inc., with dip brazing as applied to widely separated types of products. Particulars are given about research work directed toward the development of a dip-brazing technique applicable to the production of a lightweight air-to-air heat exchanger for the Boeing Flying Fortress. *Aluminum and Magnesium*, December, 1945, pages 14–17, 5 illus.

Emergency Gas Welding of Magnesium Parts. The results of a study of various methods for the emergency repair of magnesium parts by gas welding are reported. Recommended specifications of oxyacetylene equipment for making emergency repairs are listed. Information is supplied about the welding flux used to prevent oxidation, the cleaning of the casting, and welding techniques. *The Iron Age*, December 6, 1945, page 65.

Government Publications

Army Air Forces

Third Report of the Commanding General of the Army Air Forces to the Secretary of War. The third report of the Commanding General of the Army Air Forces to the Secretary of War is contained in a 72-page booklet. It deals with three phases of air power as it was developed in the final year of the war by the U.S. Army Air Forces. The first refers to the air war in Europe during 1945, the second is concerned with the air war in the Pacific during 1945, and the third discusses air power and the future. The report gives a detailed analysis of the contributions of the Air Forces to the victory of the Allies in the two principal theaters of war.

The place of air power in future international relationships is estimated by analyzing the new weapons and techniques revealed in the closing months of the conflict. Numerous photographs of air action and damage inflicted by air power are included, and maps and charts show the strategy and tactics of the Air Forces. *Office of the Commanding General, Army Air Forces,* November, 1945.

ATSC Review and Long-Range Air-Research Program. During 1945 the Air Technical Service Command returned $12,000,000,000 to the U.S. Treasury and turned to a future of aviation research designed to ensure American military security. Army Air Forces expenditures, through A.T.S.C., during the war totaled some $36,000,000,000. Shortly after Pearl Harbor, A.T.S.C. procurement amounted to $5,000,000,000 a month, and as 1945 closed this monthly sum had been cut to $80,000,000. As of November 30, A.T.S.C. had terminated more than 24,000 contracts. The contract price of the items canceled was $23,000,000,000, and all but 5,365 had been settled with a fair return to the manufacturers.

In research, the command's engineering division shifted its emphasis from development to longer range research in such fields as the aerodynamics of supersonic speed, means of aiding the human body to stand the forces of such speeds, development of propulsive forces capable of supersonic flight, and pilotless aircraft. A.T.S.C. coordinates its research and development activities with the research programs of other Government agencies and private industry.

Of the engineering division's 3,000 active research and development projects current on V-J Day, 13 per cent has been abolished. The bulk of the abandoned projects dealt with development of equipment for immediate use in combat theaters. Not only has the shift saved money that would have been spent for development of equipment that would have been outmoded in any future war, but it also freed man power and material for research into the problems of future security.

A summary of A.T.S.C. activities during the war and since V-J Day reveals the scope of the effort required to defeat the Axis. For example, a total of 228,000 Army aircraft was produced, including 16,000 gliders. Before V-J Day, production had already begun to decline from a monthly rate of about 5,000 to 3,000 airplanes, and by December, 1945, the rate had reached a level of approximately 150 aircraft per month. For the year 1945 a total of 35,000 aircraft were produced, but of this total only a few came after V-J Day.

With the end of the war, the complex machinery of the Army Air Forces had to be undone. A.T.S.C.'s division for plans, known as T-5, shifted its planning to contract terminations, demobilization, disposition of surpluses and of A.A.F.-owned-and-sponsored industrial plants and equipment, as well as the transfer of aircraft-production programs to facilitate reconversion to civilian industry. This division also prepared a report, presented to Congress on October 29, 1945, which gave the A.A.F.'s version of World War II industrial experiences, including technical and economic problems of expanding production to meet future planned mobilization. Approximately $5,000,000,000 of A.A.F. property was reported as surplus to Federal agencies for sale to private industry or other disposal.

Two major problems encountered by the command's maintenance division at the end of the war were the canceling of directives for modification and improvement of combat aircraft and the task of storage and maintenance of the thousands of airplanes and tons of equipment on hand.

Devices to control robot bombs and other guided missiles from ground installations comprise a "current project" in the equipment laboratory. Still another is research to bring about a change in the "molecular constructure of suspended moisture in icing clouds," so that this moisture gathering on an airplane can be turned into snow and thus add to safety and speed of flight.

The electronic subdivision of the command's engineering division contributed heavily to development of wartime radio and radar equipment for aircraft. With the end of the war, the subdivision turned its laboratory research toward achievement of electronic systems for all-weather flying, precision navigation, automatic blind-landing devices, radar airport-traffic control systems, and other aids to military and civilian aviation. Emphasis is also placed on development of radio control mechanisms of pilotless aircraft, rockets, and guided missiles. *Air Technical Service Command.*

AAF "Ferret" Aircraft Tracked Enemy's Radar. It has been revealed that airplanes served as aerial counterspies in ferreting out the enemy's closely guarded radar secrets. Known as "Ferrets," they were equipped with electronic devices. Flying over enemy territory, the airplanes searched for enemy radar stations and analyzed their signals to determine what radar devices could later be used to make them ineffective by jamming. In other cases, the sites of the enemy radar stations were located, and later these installations were bombed. If the enemy stations were difficult to reach, information supplied by the Ferret crew made it possible for Allied raiding aircraft to approach enemy territory by way of blind spots in enemy radar.

Designed to seek out hidden enemy radar units, the Ferrets carried equipment that not only received and recorded enemy radar signals but analyzed them for rate, size, and shape of pulse; determined their frequency; and established the geographical location of the radar.

While most of the 15 different devices carried in the Ferrets had been developed for radar countermeasures operated by the Special Projects Laboratory of the Engineering Division, Air Technical Service Command, and National Defense Research Council laboratories, two receivers familiar to most American radio amateurs were used. These were the Hallicrafters SX-28 and S-27C, both of which were redesigned for aircraft installation and operation by the Special Projects Laboratory.

Twenty-three of these radar-countermeasure aircraft were in use at the end of the war, but production had increased

Photograph, courtesy of United Aircraft Corp.

When there's work to be done on the versatile, powerful Chance Vought F4U-4 Corsair, it is dressed in a "fatigue uniform" of sponge rubber.

This workmanlike accessory is canvas bound, treaded with rope, and equipped with harness to hold it securely in place. The resilient thickness of sheet sponge rubber is an effective protection against scuffs and dents on the mirror-smooth, thin aluminum skin of the wing. More than that, the mat gives the mechanic a sure footing when the engine is revved-up in a test. As a result, there has been a decided drop in fractures and sprains due to slips and falls.

Developed as a wartime measure, this is an example of the tasks that cellular rubber, in one or another of its many forms, will perform in peacetime use. We have specialized in cellular rubber production for almost a quarter century and have never experienced such a demand as at present. We may not be able to fill your needs right now but hope you will keep this universally useful material in mind in designing products for future production. Sponge Rubber Products Co., 109 Derby Place, Shelton, Conn. Sales Offices: New York, Chicago, Detroit.

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to the point of sending out four completely equipped units each month. Quantity production of Ferrets was never set up because of the more than 2,000 lbs. of special equipment which they carried and because the operating range of each airplane was adequate to maintain surveillance of enemy radar sites over a wide area.

The first Ferret, designed by Special Projects Laboratory, Wright Field, and built at Fairfield A.T.S.C. with the assistance of the Systems Engineering Laboratory, A.T.S.C., and Division 15 of the National Defense Research Council, was started in November, 1942. The plane flew its first mission in the Aleutians early in January, 1943; to locate Japanese radar stations and determine the zone of their coverage. *Air Technical Service Command.*

Air War in the Pacific. Major Ben J. Grant and Major Robert V. Guelich. Seven articles comprise a brief history of the air war in the Pacific. Article number one discusses the victory over Japan and its effect on the future of air power, and article number two presents an analysis of the decline and fall of Nippon's air strength. In the third article, the period when the Japanese forced the Allies back to the gates of India and Australia is traced; in the fourth, it is told how the Allies turned the tide with new techniques in the use of air power. Articles five and six deal with the air offensive against Japan and the Superfortress campaigns against the Japanese home islands, while the last article consists of a chronology of major events in the Pacific from Pearl Harbor to victory. *Air Force*, December, 1945.

Civil Aeronautics Administration

Report on the Boston-Midwest Project. An analysis is provided of the data accumulated in the course of an investigation conducted by the Committee on Selection and Training of Aircraft Pilots, in and around Boston, Mass., and Columbus, Ohio. The work comprised an integrated program of research involving the evaluation of predictors and criteria found to be promising through earlier research. It is stated that, although the study failed to produce material of striking significance with respect to the predictors employed in the investigation, advances are indicated in the area of criterion measures, particularly with respect to the possibility of using a composite criterion as a means of more fully describing flight performance.

The study is a part of the series sponsored by the Committee, involving a coordinated program of civilian research in aviation psychology, conducted in scattered centers with the cooperation of local institutions and psychologists, and financed by the Civil Aeronautics Administration through the National Research Council. *Report No. 52, National Research Council, Committee on Selection and Training of Aircraft Pilots,* November, 1945.

Radio Equipment for the Private Pilot. A summary of the C.A.A.'s latest plans concerning V.H.F. radio facilities for private fliers is given in 4 loose-leaf pages. This release is intended to aid manufacturers in the design of radio equipment for personal planes. It is stated that, while the plans are tentative and final details still are under study by the Radio Technical Committee for Aeronautics, the C.A.A. is confident that the major features are acceptable to all interested persons and can be used as a basis for design. *Office of Aviation Information, Signals Division,* November, 1945.

Civil Aeronautics Board

Commercial Air Transportation in Mexico. Albert G. Sweester, Caroline B. Dwight, Mary C. Hillyer, and J. Maxine Pressly. Supplemented by a series of cartographs, information about commercial air transportation in Mexico is presented in a 32-page pamphlet compiled by the Air Transport Division of the C.A.B.'s Economic Bureau. Summarizing the background of air commerce in Mexico and the legal framework that supports it, the writers go on to discuss Mexican industrial air lines, common carriers, tariffs, and equipment. They also investigate the situations with regard to airports and air-mail services. Comments upon future trends of, and plans for, air transportation in Mexico complete the publication. *Air Transport Information Division,* September, 1945.

Navy Department

The No. 3 Tank for Model Seaplane Tests. Walter Fried. Report No. 289 describes the No. 3 experimental towing tank for model seaplane tests. According to the report, the tank is 12 ft. wide and 6 ft. deep and provides additional facilities for testing models of seaplane hulls at speeds up to 60 ft. per sec. A new two-story building at the Stevens Institute of Technology houses both the tank and offices, shop, photographic department, and miscellaneous utilities. It is stated that the facilities were constructed under the sponsorship of the Bureau of Aeronautics; the building and equipment are the property of the Government; and the land is owned and leased to the Government by Stevens Institute. Salient terms of the Bureau's contract covering the No. 3 tank are included in the report. *Bureau of Aeronautics, Report No. 289,* October, 1945.

Surplus Property Administration

White Elephants with Wings. The plans for disposal of surplus Government aircraft are outlined in a pamphlet of 20 pages. The principal sections of the pamphlet deal with the determination and the extent of the surplus property of that type, answers to the questions of what to do with surplus airplanes, a listing of the five classes of surplus aircraft, an explanation of how surplus planes are sold, and a report of the work done in finding uses for surplus material. Photographs, sketches, and charts are included.

British Information Services

Flight and Model Tests of the "Hawcon" with Wings 33% Thick at the Root. Previous tests of the low-wing experimental monoplane "Hawcon," with wings of thicknesses 15 per cent, 20 per cent, and 25 per cent at the root, had shown that the effect of increasing the root thickness to 25 per cent was not seriously deleterious to the aerodynamic qualities of the aircraft. These experiments were continued by flight and model tests of a wing 30 per cent thick at the root to throw further light on the effect of wing thickness on performance and on the question of the design fillets for thick wings and to investigate the flying qualities of an aircraft fitted with this unusually thick wing.

The investigation was divided into two parts—the first involving flight tests and the second, model tests. In Part I, the profile drags of two sections of the wing, 26.9 per cent and 29 per cent thick, were determined by the momentum method; transition points were located on the former section; and the results were compared with calculated values. The overall drag of the aircraft was estimated from performance tests and compared with similar results for the previous three sets of wings. Lift and drag curves were established, and the maximum lift coefficients with flaps up and flaps down were determined. Finally, the general handling qualities of the aircraft were investigated. In Part II, lift, drag, and pitching moment were measured on a one-tenth scale model with various fillets to see if the performance could be improved by change of fillet design.

From performance tests of the "Hawcon" with wings 30 per cent thick at the root, the drag coefficient is estimated to be 0.0255, of which 0.003, or 12 per cent, is additional interference drag, as compared with the previous sets of thinner wings. Model tests gave results in conformity with this, and tests with various fillets showed that the drag could not be greatly reduced by change of fillets. The measured profile drags agree well with calculated values based on observed transition-point positions. The transition points are at about 0.31c over the inner part of the 30 per cent wings. The maximum lift coefficients measured in flight with flaps up and flaps down are low (1.06 and 1.60) because of the thick wing section. In general, the handling qualities of the aircraft have not been adversely affected by the increased wing thickness, but the ailerons are not effective for small displacements. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1937,* British Information Services, New York, $2.10.

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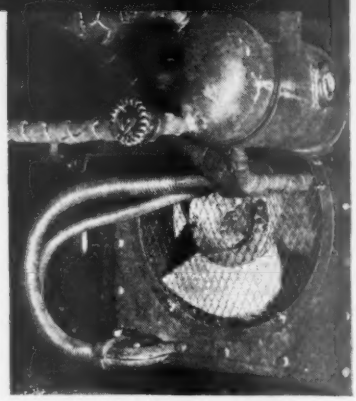

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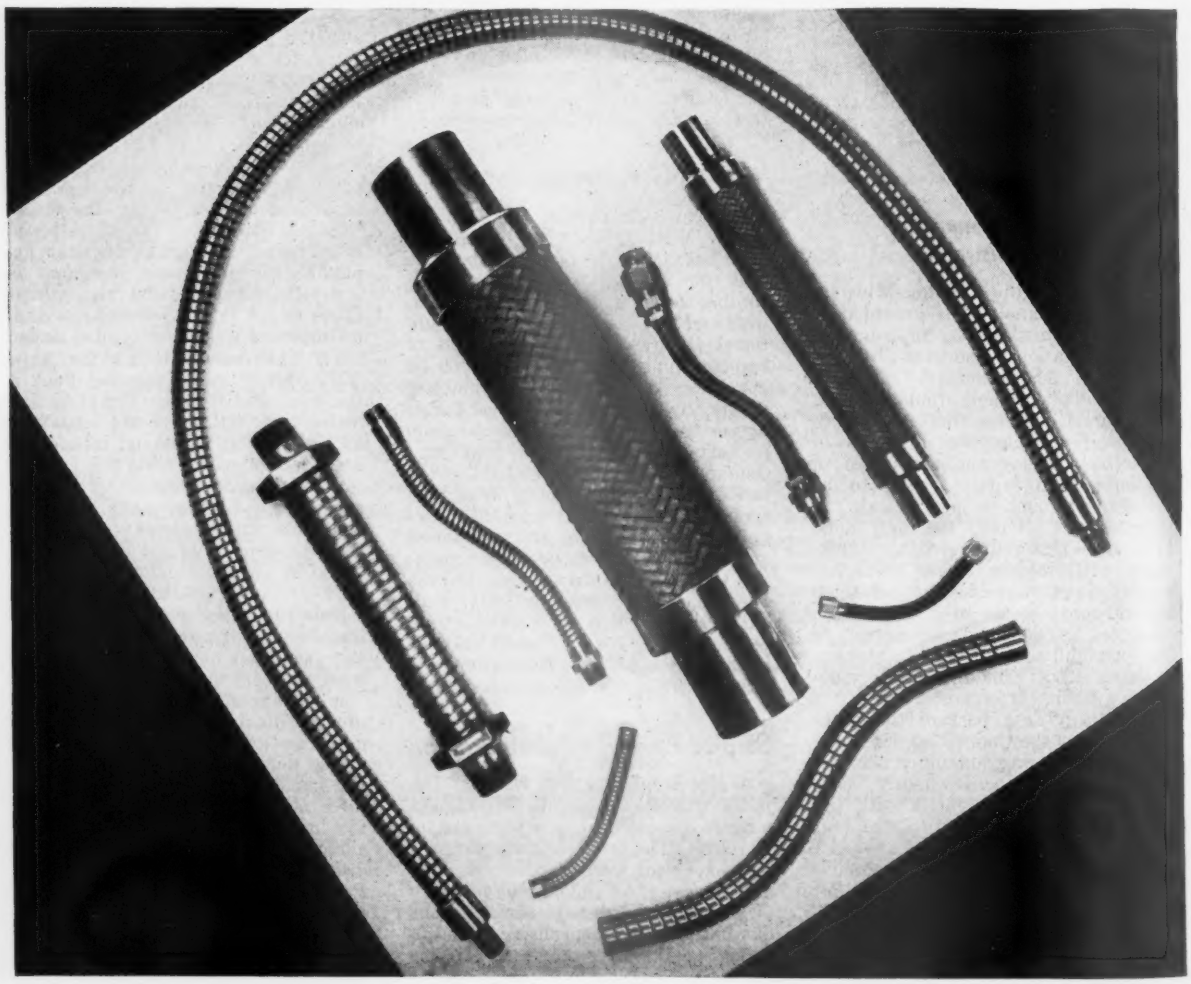

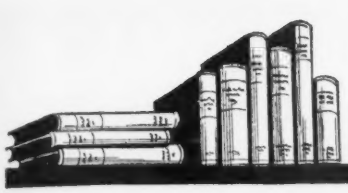

BOOKS

The Modern Wonder Book of the Air

Norman Carlisle, Reginald Cleveland, and Jonathan Wood

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Written by men who are authorities on their subjects, this review of aviation outlines, for young readers as well as older, a comprehensive picture of what aviation has done, is doing, and may do in the future. Historical references are interwoven with visionary projections of future possibilities in such a way as to make interesting and informative reading.

The illustrations are well chosen and cover a wide range, from the pioneering era to the prophetic. Few books on aviation have the wide scope, the authenticity, and the readability of this record of man's achievement of flight. The John C. Winston Company, Philadelphia, 1945; 316 pages, $2.50.

Aerial Navigation

H. E. Benham

Contents: The Earth; Charts and Maps; Dead Reckoning; Tactical Navigation; Radio Navigation; Aircraft Instruments; The Flight; Astro-Navigation; The Astro-Line of Position; Astronomy and Star Identification; Magnetism and Compass Deviation; Meteorological Aspects of Navigation.

The author's aim has been to provide students with a practical text on avigation which will dispel the prevailing idea that navigation, particularly celestial navigation, is a difficult science, and at the same time avoid the substitution of rules-of-thumb for explanations. The student is provided with the basic fundamentals necessary as a preliminary to the finishing school in flight. John Wiley & Sons, Inc., New York, 1945; 344 pages, $4.00.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N. Y.

Aircraft Recognition Without Tears

Squadron Leader J. C. Gent

Contents: First Principles; The Theory of Flight; Design and Construction of Aeroplanes; The Nose; Engines; Wings; Fuselage; Tail-Unit; Oddments; Examples; Optical Illusions; Sit; Biplanes; What to Study; Conclusion; Silhouettes.

Going further than most books on aircraft recognition, this manual not only gives three-view silhouettes of the leading Allied and Axis aircraft, but instructs the reader in the recognition of each part as well. The principles of the theory of flight and the design and construction of aircraft lay a foundation for the understanding of the different outlines of each section of the exterior of the airplane.

For those who wish to be able to identify aircraft with discrimination the book will serve as a practical guide. Sampson, Low, Marston & Company, Ltd., London, 1944; 180 pages, 7*s.* 6*d.*

To-Morrow's Airliners, Airways, and Airports

S. E. Veale

Contents: To-Morrow's Airliners; To-Morrow's Airways; To-Morrow's Airports; To-Morrow's Air Jobs; The Histories of British Airways; Map of World's Air Routes.

In a serious and comprehensive study of air transport, Mr. Veale gives a broad and detailed picture of the present and future of world commercial aviation. His exhaustive description of the air liners of the future not only examines the qualities that will be required, but lists the leading types that are now being built or are in prospect.

The problems involved in establishing international air routes with facilities for larger aircraft, passengers, and cargo are discussed with informed comment. The difficulties of the private flier are considered, as well as measures to assure his safety and convenience. Airports, both land and marine, are studied in detail and the many management problems discussed indicate what may be expected to be accomplished in the operation of world air services with safety and regularity.

In a concluding chapter various opportunities for jobs with air lines are listed, with the qualifications required for each. A chronologic history of British air-transport companies and a map of the air routes of the world as they existed in 1939 are given. Pilot Press Ltd., London, 1945; 337 pages, 15*s.*

Waveform Analysis

R. G. Manley

Contents: Sine-Waves in Combination; General Properties of Harmonic Series; Basic Analysis of Recorded Waveforms; The Envelope Method; Method of Superposition; Fourier Series: Mathematical Analysis; Numerical Methods; Mechanical and Other Aids to Analysis; Practical Requirements for Waveforms; Lissajou Figures. Appendixes: Choice of Sine-Waves as Basic Components of Waveforms; Uniqueness of Fourier Series Expansion; Effect of Non-Harmonic Components, or of Choosing a False Cycle; Demonstration of Fourier's Theorem; Useful Trigonometrical Formulae, and Tables for Synthesis.

The author has included the basic theory and methods of analysis required to provide the reader with a groundwork of knowledge concerning the properties of complex wave forms. The envelope method of analysis used by the author, in connection with research work in the vibration department of The de Havilland Aircraft Company, Ltd., is set forth in detail.

The method enables recorded wave forms to be separated into their principal constituents without recourse to mechanical contrivances or the more exact but cumbersome methods known as Fourier analysis or Harmonic analysis. Through the methods given, thousands of recorded wave forms may be interpreted by analysis. A glossary, answers to exercises, and a bibliography are appended. John Wiley & Sons, Inc., New York, 1945; 275 pages, $4.00.

Lockheed "leadership"
includes AEROLS!
Renowned for speed, size and safety, the "Constellation" typifies the famed slogan, "Look to Lockheed for Leadership." Quality and reliability distinguish every component of the "Constellation"—explaining why this outstanding transport plane is equipped with Aerol landing gear.
America's biggest planes are equipped with Aerols to cushion landing shock and protect plane, crew and cargo. Introduced when aviation was still in its infancy, Aerols are contributing substantially to aviation's progress—as planes grow in size, weight and speed, Aerols solve their landing problems.
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*PNEUMATIC-HYDRAULIC (AIR-OIL) SHOCK ABSORBING LANDING GEAR

Meteorology for Airmen

Charles A. Zweng

Contents: The United States Weather Bureau Meteorological Service to Airmen; Elements of Meteorology and Structure of the Atmosphere; Weather Maps and Teletype Sequence Reports; Moisture of the Atmosphere; Heat Energy and Stability of the Atmosphere; Pressure and Wind Circulation; Air Masses; Fronts and Thunderstorms; Fogs and Aircraft Icing; Airway Forecasts and Their Interpretation; Weather Forecasting Procedure; Altimeter Setting and Airspeed Correction; Winds Aloft Reports.

The purpose of the author has been to supply the airman with a text that will give him a basic understanding and foundation in aeronautical meteorology. The manual is intended for those seeking a pilot certificate, an instrument rating, or air-line rating, and also for the use of air-line dispatchers and ground instructors. Subjects such as gradient and geostrophic winds, variations in altitude when flying from high- to low-pressure areas, and lapse rates are treated from a nontechnical point of view. Appendixes contain a list of technical terms, questions and answers, and typical examination questions. Pan American Navigation Service, North Hollywood, Calif., 1945; 231 pages, $3.00.

Book Notes

Journey Underground, by Flight Officer David G. Prosser; E. P. Dutton & Company, Inc., New York, 1945; 347 pages, $2.75.

A vivid picture of the daring of the French families who risked their lives to protect American and British airmen from the Germans is given by an American pilot who parachuted from his P-47 over France and was assisted by the French underground.

Books such as this provide a realistic picture of life during the German occupation and record a phase of the war effort that will always be remembered with gratitude by the countries of those airmen who were saved from being taken prisoners by the enemy.

Wingspread, by Leo White; Whites Aviation Limited, Auckland, New Zealand, 1945; 192 pages.

When a history of the development of aeronautics in all parts of the world is written, books of this type will afford the background material. In this review of the aeronautical achievements of the people of the island dominion, the author shows that in New Zealand ballooning was popular in the 1890's, and that as early as 1910 attempts were made to build aircraft. From that time forward there was continuous activity in air transport, private flying, service aviation, and record-making flights.

Here will be found the names and records of the aeronautical pioneers of New Zealand. Written by one who knew them all, the current book (which is a revision of an earlier edition) is a testimonial to the foresight of the early experimenters, whose accomplishments stimulated so many of their successors to join the air forces in the last two wars.

The Wing, by Rom Landau; Faber and Faber Ltd., London, 1945; 331 pages, 16*s*.

An author of numerous English books, commissioned in the R.A.F. to assist in organizing the Polish airmen, decided that he wanted to become an air gunner. He describes his experiences, some of which were not pleasant, while on duty at various R.A.F. stations. The account, much of which is taken from the author's diary, portrays the life of a flight lieutenant while undergoing training.

It's Tomorrow Out Here, by Max Miller; Whittlesey House, New York, 1945; 186 pages, $3.00.

Some of the most interesting photographs of Okinawa, Iwo Jima, Guam, and other Pacific islands, taken by Lt. Comdr. Charles E. Kerlee, have been selected by Max Miller, a well-known writer who served in the Navy with the rank of Lieutenant Commander. The author has supplemented the pictures with text matter giving a first-hand view of the life and work of the Navy in its progress toward Japan.

The concluding chapters describing life on an aircraft carrier, contain an abbreviated account of the broader description in the author's *Daybreak for Our Carrier*.

Fighters, by Leo White; Whites Aviation Ltd., Auckland, New Zealand, 1945; 46 pages.

The work of the pilots of the Royal New Zealand Air Force in the Pacific is stressed in a booklet written by an official photographer attached to the R.N.Z.A.F. The pilots performed notable feats of bravery in the war and participated in the campaign for the Solomons from May, 1943 onward, flying what is called the "aerial ladder" from their home islands to the Solomons. From bases established on one after another of those islands, they provided air cover for the New Zealand ground forces and engaged in many furious air encounters with the Japanese, destroying 99 Japanese aircraft.

The reader is made well acquainted with the lives of these airmen, following them in their activities in camp and in their individual and collective battles with the enemy. The illustrations include portraits of squadron leaders, scenes at various air bases, and maps of the Solomon Islands area.

5,000 Miles Towards Tokyo, by Green Peyton; University of Oklahoma Press, Norman, Okla., 1945; 173 pages, $2.50.

How an aircraft carrier is operated under wartime conditions is described in this account of the work of the U.S.S. "Suwannee." Centering his story around Air Group 60, which took part in every important Pacific invasion from the Gilbert Islands to the Philippines, the author gives a graphic account of the progress of the invasion, as seen from the deck of the "Suwannee."

Starting at Tarawa and ending at Leyte Gulf, the attacks and counter-attacks made are described. Exploits are personally related so that the reader learns how the pilots and crewmen felt about their part in the war in the Pacific. It is a brilliant account of the amphibious operations from the American West Coast to the gates of Tokyo.

Night Bombing, by Hector Hawton; Thomas Nelson and Sons Ltd., London, 1944; 164 pages, 5*s*.

From small beginnings during the first World War, bombing from aircraft is traced through its development up to the period of around-the-clock bombing by the R.A.F. and the A.A.F. Little is written about the latter, but the problems encountered in meeting the bombing by the Luftwaffe and how the British decided to build heavy bombers which would be able to bomb at night without too great precision are described in detail. The success of this accomplishment, with the more accurate bombing by the American day bombers finally prepared the way for the ground invasion.

Sowing the Wind, by Martha Dodd; Harcourt, Brace and Company, New York, 1945; 311 pages, $2.50.

The daughter of an American Ambassador to Germany had unequalled opportunities to observe the workings of the higher levels of the Nazis. Although the Germans who are described in Miss Dodd's book are in many cases given assumed names, it is not difficult to identify them.

She shows the complete disintegration of character under the influence of Hitler and his henchmen. Life in Berlin and the smaller cities shows the compelling onrush to the war and the efforts made by a few to combat the leaders in that movement.

The social life with its servile flattery of the Nazi leaders, the strutting about in overly bemedalled uniforms, the fear and subservience of the wives, and the power of the mistresses are all described in this powerful indictment of German officialdom.

The unfolding of the rise of the German clique as related by the author emphasizes anew the dangers which were inevitable had these men, obsessed with world domination, not been overpowered.

The Dragon and the Eagle, by Delia Goetz; Foreign Policy Association, New York, 1945; 61 pages, $1.00.

A rugged performer with a big voice and keen ear!

Collins AN/ARC-2 Autotune transmitter-receiver

The AN/ARC-2 Autotune transmitter-receiver was designed and is built by Collins for two place and larger military aircraft. It is an example of the experience, design ingenuity and manufacturing skill also available, in the Collins organization, to commercial users of communication equipment.

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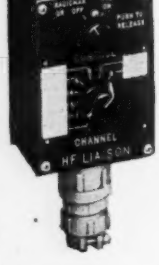

Transmitter, receiver and dynamotor are all contained in the same case. The weight and space requirement of the AN/ARC-2 is considerably less than that of the equipment it replaces. Any one of eight pretuned channels is immediately and automatically available by means of the Collins Autotune, operated either at the main panel or by remote control. The transmitter and receiver operate on the same frequency and are tuned simultaneously by a single set of controls.

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The relations between China and the United States are reviewed in a small book, the main purpose of which is to encourage further cooperation between the two nations. It traces the progress of relations with China and shows how traders established business connections with the Chinese, brought Chinese products to other parts of the world, and spread knowledge of Chinese art and culture among the countries of Europe and America. The work of the Flying Tigers during World War II in clearing the skies and making way for the great air-transport supply lines over the Hump from India is described.

Written for the layman, the short study familiarizes the reader with some of the more difficult problems the Chinese have to face.

This Is Where I Came In, by Robert J. Casey; The Bobbs-Merrill Company, New York, 1945; 307 pages, $3.00.

An author of many books covering varied fields of fiction, war, and travel, has written of his observations of the war in Africa and Europe. Impressions of the moving panorama of historic events are keenly observed and evaluated. While there is little about the war in the air, its effects in all areas are depicted.

Well Done! by Morris Markey; D. Appleton-Century Company, Inc., New York, 1945; 223 pages, $2.75.

In 1943 the author was accredited to the Navy as a war correspondent, went to North Africa, and later was moved to the Pacific area. His description of the Marianas campaign is a classic account of men fighting against the sea, the weather, and the enemy.

From the aircraft carrier "Essex" he watched Air Group 15 operate, and the events recorded center principally about these men. As a free observer he discussed the actions with many of the 2,500 men aboard the carrier, and gives their impressions of the various engagements in which they took part.

Spotters Album of Types Past and Present, Series I and II; The Harborough Publishing Company, Ltd., Leicester, England, 1945; various pagings, 2 volumes, 5*s*. each.

Two small manuals give pictures and descriptions of the leading aircraft used in World War II by Great Britain, United States, Russia, Holland, Poland, Germany, Italy, France, and Japan. They are handy reference guides which give "background knowledge" required by aircraft observers during their service in the war.

The Flying Reporter, by Lewis E. Theiss; Wilcox & Follett Company, Chicago, 1945; 312 pages, $1.00.

The newspaper industry has been a user of airplanes for many years; its reporters have flown to distant places for on-the-spot information and their experiences have been exciting and varied.

Lewis Theiss's book recounts some of the events in the life of a reporter who covered fires, floods, and other sensational events by air. It demonstrates how a newspaper man disregards personal safety in quest of his story and the lengths to which he will go to get first-hand interviews.

Southwest Pacific Sketchbook, by Cedric Emanuel; Prentice-Hall, Inc., New York, 1945; 63 pages, $3.50.

These drawings will bring back nostalgic memories to officers and men who have lived on the Pacific islands. Artistically drawn and beautifully reproduced, the pictures and text perpetuate experiences of a wide field of military activities among primitive scenes and peoples.

Atomic Artillery and the Atomic Bomb, by John Kellock Robertson; D. Van Nostrand Company, Inc., New York, 1945; 173 pages, $2.50.

As a primer on radioactivity, how it was discovered and grew into one of the most important branches of science, Mr. Robertson's book will serve as an authoritative guide. It is a basic book on atomic energy, which traces the search for the innermost secrets of matter. In simple language which does not entail a knowledge of mathematics or science, it explains the steps by which matter is changed into energy.

More Fighters of the Present War, by Capt. Ellison Hawks; Real Photographs Company Ltd., Southport, England, 1944; 58 pages, 5*s*.

Supplementing an earlier book on fighting aircraft, a new handbook describes other and later designs. Twenty-two aircraft are listed with pictures and text.

The descriptions are more detailed than usual and serve to give credit to the manufacturer and the designer.

From Trail Dust to Star Dust, by Edward A. Starr; The Transportation Press, Dallas, Tex., 1945; 260 pages, $3.00.

The author's story of the development of American transportation takes the reader through the early period of trail-breaking overland to the West Coast; the upsurge of water routes—sea, lake, river, and canal transportation; and the development of the railroads into a network spreading over the United States. The concluding chapters are concerned with motor-vehicle and air transport.

The chapters on aviation fit in with the overall picture of transport and suggest the changes that this newest form of transport may effect in world affairs.

The Builders of the Bridge, by D. B. Steinman; Harcourt, Brace and Company, New York, 1945; 457 pages, $3.50.

The romance of the early bridge engineers and builders, John A. Roebling and his son, Washington A. Roebling, is one of the epic stories of American industry. The Roeblings were not only pioneer bridge builders but founded the firm of cable manufacturers which has expanded until it embraces many aircraft interests.

Skillfully told, the biography embodies a tribute to the spirit that inspires engineers in their creative work.

Atomic Energy in War and Peace, by Gessner G. Hawley and Sigmund W. Leifson; Reinhold Publishing Corporation, New York, 1945; 211 pages, $2.50.

The reticence of the authorities in releasing information regarding the work of the atomic scientists has made it difficult to arrive at an understanding of some of the fundamentals of this new development. The authors trace the history of the study of the atom and radioactivity in greater and more explicit detail than official publications, so that the reader is given a more satisfying background for understanding of nuclear fission and other fundamentals involved in the control of atomic energy. This work should aid in giving a clear view of the intricacies of the radioactive substances and their possible utilization in war and in industry.

A Complete Course in Elementary Aerodynamics, by N. A. V. Piercy; The English Universities Press Ltd., London, 1944; 305 pages, 21*s*.

Only a limited knowledge of mathematics is required on the part of the student to understand the aerodynamic principles set forth in this text. Numerous examples are provided to illustrate scientific and practical applications of the principles and methods. For the experiments only simple apparatus is required. Of the various parts of the science of aerodynamics involving advanced mathematics, difficult experiment, or technical complexity, the majority are discussed qualitatively, including the dynamic stability of airplanes, aerodynamic efficiency, and the Lanchester-Prandtl theory of wings.

Navigating Your Airplane, by Creighton Merrell; McCormick Armstrong, Wichita, Kan., 1945; 92 pages, $2.00.

The author's aim has been to provide a book for the teaching of navigation in the simplest and most direct manner possible. The emphasis is on private flying. The various methods of navigation are explained and the methods are applied to a cross-country trip. Other sections of the book deal with time and longitude, maps and chart reading, and plotting a course. There are also chapters on navigation instruments, the wind, and radius of operations.

Mechanics for Engineers, by Edward R. Maurer, Raymond J. Roark, and George W. Washa; John Wiley & Sons, Inc., New York, 1945; 425 pages, $4.00.

Originally titled *Technical Mechanics*, this revised and amplified text on theoretical mechanics deals with statics and dynamics as usually taught at the undergraduate level. In deciding on the scope of the book, the authors took into consideration present teaching practice in American schools of engi-

neering and the trend toward more thorough and advanced instruction in mechanics, especially in dynamics.

A.S.T.M. Standards on Petroleum Products and Lubricants; American Society for Testing Materials, Philadelphia, 1945; 546 pages, $2.75.

The 1945 edition of *A.S.T.M. Standards* for petroleum products and lubricants contains reports of methods of testing these products, specifications, definitions, charts, and tables. One section describes the method of test for the knock characteristics of aviation fuels.

Your Airlines, by Daniel Lionel; Brooklyn Eagle Press, Brooklyn, N.Y., 1945; 20 pages.

A pamphlet containing reprints of articles written by Daniel Lionel, Brooklyn Eagle Air Transportation Director. They were published in the *Brooklyn Eagle* and endeavor to present the background and future plans of the air lines entering New York City.

Airplane Operations and Maintenance Manual; Aero Insurance Underwriters, New York, 1945; 96 pages, $2.00.

A manual of good practices and procedures for the operation and maintenance of aircraft has been prepared for the guidance of executives who use aircraft in industry. The manual is bound in loose-leaf form so that sections dealing with new procedures that contribute to the safe operation of aircraft may be added as they are developed.

UHF Radio Simplified, by Milton S. Kiver; D. Van Nostrand Company, Inc., New York, 1945; 238 pages, $3.25.

Ultra-high-frequency radio is explained in easily understood language. The author has avoided the use of complex theory and mathematics. Information is given about the principles and applications of the various types of ultra-high-frequency equipment.

Newnes Plastics Manual, by F. J. Camm, H. W. Gilbert-Rolfe, and D. C. Nicholas; George Newnes Limited, London, 1945; 272 pages, 17*s.* 6*d.*

Useful information about plastics is supplied in this manual. The book deals with the chemistry of plastics, practical applications of these materials, and the machinery necessary for working them. The design and construction of molds is discussed. The physical characteristics of most of the well-known British plastics are listed.

Proceedings of the First Annual Short Course and Conference; School of Engineering, Texas Engineering Experiment Station, College Station, Tex., 1944; 210 pages.

A bulletin presents the transcript of the first airport and management course and conferences sponsored by the Agricultural and Mechanical College of Texas. It records all the talks and pertinent discussion.

Following a report of the general assembly, with the introductory and concluding remarks of the chairman, the bulletin is divided into sections dealing with problems of airport management; problems of airport operation; airport planning, location, financing, design, and construction; and problems of airport maintenance.

A Report on American Aerodromes and American Civil Aviation, by C. M. Newton and O. C. Purnell; The Aerodrome Owners Association, London, 1943; 18 pages.

The results of an inspection of American airports and civil aviation, carried out by a committee of the Aerodrome Owners Association of London, are reported in a pamphlet. The investigation was conducted by a representative of commercial owners and a representative of municipal owners. The subjects discussed include transatlantic services, airways, superairports, the smaller airports, airport runways, traffic control, airport fees and charges, and the control of civil aviation.

Sources of Information on Instruments; The American Society of Mechanical Engineers, New York, 1945; 23 pages, $0.75.

A set of source lists compiled to aid those requiring information about laboratory and industrial instruments. Sections contain references that give a broad coverage of basic theory and constructional detail; references more specialized in scope; periodicals concerned with laboratory and industrial instruments; specialized bibliographies; indexes; sources of information about patents and academic theses; and guides to publications. The last part of the pamphlet contains instructions for preparing an annotated bibliography.

Photography in Engineering, by C. H. S. Tupholme; Faber and Faber Limited, London, 1945; 276 pages, 42*s.*

Records are given of what the camera is doing for engineers and suggestions are made regarding what can be done in the future to make the works photographic department one of the most reliable factors in maintaining quantity and quality of production. Photographic techniques used in the various branches of the engineering and allied industries, including the aircraft industry, are described. While all the essential data and illustrations are given, for those who wish to delve more deeply into other techniques a selected bibliography is provided at the end of each chapter. Information is supplied about photographing drawings, photography in the laboratory, high-speed photography, radiography, infrared photography, and instructional motion pictures.

Air Freight for Fresh Fruit and Vegetables; United Fresh Fruit & Vegetable Association, Washington, D.C., 1945; 16 pages.

A report in pamphlet form incorporates findings and conclusions based on the air shipment, approximately 365,000 lbs., of fresh fruits and vegetables from California to eastern terminals during several months. Air shipment methods and operations are described and illustrated.

Transportation in American Popular Songs; Grosvenor Library, Buffalo, N.Y., 1945; 45 pages.

American sheet music in the Grosvenor Library having to do with transportation is listed in a bibliography. A section is given to popular songs having an aviation theme.

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World War II in Our Magazines and Books, compiled by Henry O. Spier; Stuyvesant Press, New York, 1945; 96 pages, $2.25.

Books, pamphlets, magazine articles, newspaper clippings, and other records dealing with the military, political, and economic history and background of World War II, as well as with domestic and world peace problems, are listed. Books and articles on aviation aspects of the war are included.

Power in the Pacific; Museum of Modern Art, New York, 1945; 30 pages, $1.00.

A pamphlet compiled from an exhibition at the Museum of Modern Art, New York, contains official U.S. Navy, Coast Guard, and Marine Corps photographs of operations in Pacific war theaters. Illustrations of aircraft in action are included.

Plastics, by Bernard Wolfe; The Bobbs-Merrill Company, New York, 1945; 189 pages, $2.50.

Descriptions are given in simple language of what plastics are, what is being done with them, and the ingredients, processes, and machinery used in their manufacture. In a chapter on bonded plywood the author discusses the application of this product to aircraft and outlines some of its advantages. Included is an industry guide that lists the types of plastics, the firms manufacturing them, and the trade names of the products.

Books Published in the United States, 1939–1943; American Library Association, Chicago, 1945; 85 pages, $1.25.

This list was compiled to inform reference libraries, government agencies, and individual scholars in war areas of important American books published since the beginning of the war and to serve as a buying list for books to be purchased, for libraries in war areas, with funds provided by the Rockefeller Foundation.

1944 Supplement to the Bibliography and Abstracts on Electrical Contacts; American Society for Testing Materials, Philadelphia, 1945; 30 pages, $2.00.

The 1944 supplement to a bibliography on electrical contacts which was published in 1943. The form of the supplement is the same as the original bibliography, which included the period from 1835 to 1942.

The Electronic Engineering Master Index, edited by Frank A. Patraglia; Electronics Research Publishing Company, New York, 1945; 318 pages, $17.50.

Electronic engineering articles that have been published in periodicals during the past 20 years are listed. The bibliography is divided into two parts: Part I deals with the period from January, 1925, to December, 1934; Part II, from January, 1935, to June, 1945. The titles of pertinent articles and texts are grouped under conventional electronic subject headings. Abundant cross references are provided, and a cross index of topics is included in an appendix.

Fundamental Theory of Servomechanisms, by LeRoy A. MacColl; D. Van Nostrand Company, Inc., New York, 1945; 130 pages, $2.25.

A general expository paper on the theory of servomechanisms is offered in book form. It is intended to constitute a comprehensive introduction to the fundamental theory and is concerned mainly with the general theory applicable to all linear servomechanisms for continuous operation. Emphasis is placed on the essential identity of that theory with the highly developed theory of feedback amplifiers. Certain particular servomechanisms are described, but no attempt is made to discuss the many details that must be considered in the practical design of servomechanisms.

Antwerp Under V1 and V2; Uitgever "Ontwikkeling," Antwerpen, Belgium, 1945; 48 pages, 25 francs.

The destruction visited upon the city of Antwerp, Belgium, by the German V1 and V2 rocket missiles is illustrated and described in a pamphlet printed in three languages—English, Dutch, and French—in parallel columns. The attacks by flying bombs took place after the Germans had retreated from that part of Belgium and after the city had been occupied by the Allied forces. The text gives a chronological record of the hits, the damage they inflicted, the steps taken to offset the effects of the bombings, and the reconstruction work undertaken.

Fiction and Juvenile Books

We Always Come Back, by James Allen; Peyton Paul, New York, 1945; 223 pages, $2.50.

A Liberator navigator relates the experiences of the officers and men during the last of the raids of the "Boomerang" over Germany. The rugged language employed by pilots is used frankly and without reticence.

The adventures of the navigator and his fellow crew members during many bombing missions over Germany are recounted. There are stories of the preparations for attacks on enemy targets, the damage inflicted on the enemy and sustained by the bombers, injuries of the personnel, narrow escapes, and return flights to the air base. Space is given to detailed descriptions of the leisure-time activities of the airmen and other Allied fighting men. The novel deals in an intimate manner with the emotional reactions of the men to the severity of the physical and mental stresses to which they were subjected in connection with their work.

The High Barbaree, by Charles Nordhoff and James Norman Hall; Little, Brown and Company, Boston, 1945; 230 pages, $2.00.

Two writers who have been prolific in describing life in the South Seas in books and magazine articles have written a fantasy that opens with the forced landing of a Catalina flying boat. The pilot's fancied adventures center about life on a small uncharted island, where he meets his fiancee, an Army Nurse, and his uncle, Captain of a merchant vessel.

Careless Lives, by Desmond Leslie; MacDonald & Company Ltd., London, 1945; 214 pages, 8*s.* 6*d.*

The son of Shane Leslie, the famous Irish writer, has written his first novel. He was a fighter pilot, and, although the novel is not autobiographical, it could only have been written by one who had many personal experiences.

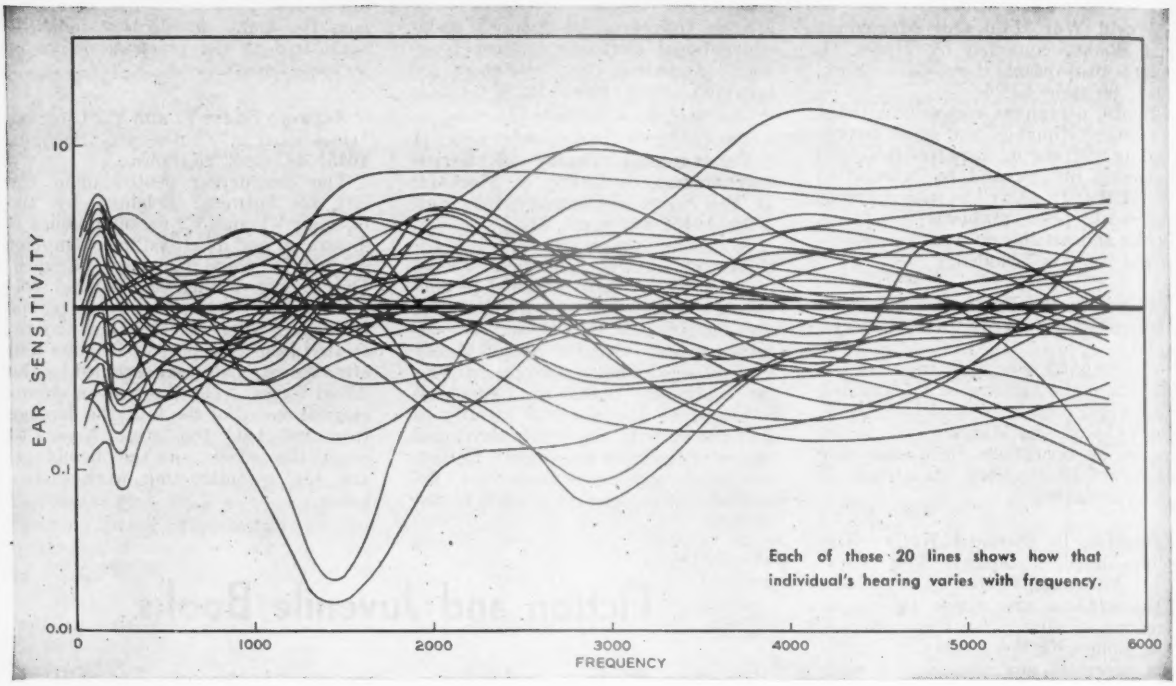
The story follows the career of a novice who joins the Royal Air Force, is sent to Florida for his training, and returns to take part in the raids over Germany.

The main thread of the romance concerns an English girl who owns a historic castle. She joins the Women's Auxiliary Air Force and falls in love with the pilot. Her devotion is remembered while he is undergoing pressure amid the social life of Palm Beach and New York.

The most interesting parts of the novel are the descriptions of high social life in the United States and England during the war. They show how English trainees were entertained while in this country by those who seemed to be able to provide unlimited gasoline and food for their guests at a time when most of the American people were accepting rationed amounts of the necessities of life. It is not a complete picture of life in either country because it touches only the more exclusive social circles.

Beach Red, by Peter Bowman; Random House, New York, 1945; 122 pages, $2.50.

Taking a single hour in a soldier's life during a Pacific island invasion, Peter Bowman describes the battle scenes and explores the mental processes of a corporal engaged in an amphibious assault. It is written in prose but is set in type lines like those used in setting poetic blank verse. This typographic style was used by the author to represent the strict timing by which such military actions are governed. The story reveals the soldier's thoughts about war and its relation to the world of the future.



To measure is to know

Twenty-five years ago, one standard of sound power was the ticking of a watch, another was the clicking of two coins; and the measure was how far away the tick or the click could be heard. That test was made in measuring people's hearing, a field of interest to the Bell System scientists because the ear is the end-point of every talking circuit.

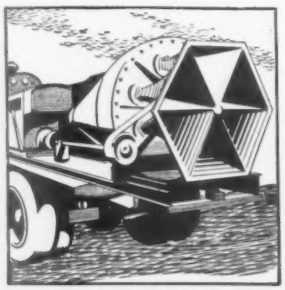
Accustomed to exact measurements, Bell scientists proceeded to develop a method of measuring hearing-sensitivity in terms which could be precisely defined and reproduced. After plotting hundreds of runs like those above, they decided on a particular sound intensity, representing an average "threshold of hearing," as a starting point.

The sounds delivered by a telephone line had previously been evaluated by listeners who compared their loudness with that of a standard source. There were wide variations in ears, as the chart shows, so the engineers replaced them by electrical instruments. When later their associates developed the Western Electric radio and public address systems, the necessary measuring circuits were promptly forthcoming. Addition of a standard microphone made a noise meter, widely used in quieting airplanes and automobiles.

"Through measurement to knowledge," said a famous Netherlands scientist. The principle finds wide application in Bell Laboratories, whether the quest be for a way to measure sound, a new kind of insulation, or more economical telephone service.

Hearing was first measured reliably by engineers in the Bell Telephone Laboratories

For good reception, program loudness must stay within certain limits. Volume-meters help to hold it there



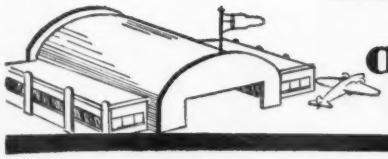
From the throat of this mighty air-raid siren comes the loudest sustained sound ever produced

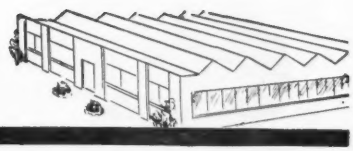
Visible Speech, result of telephone research, turns sound into "pictures" that the deaf can read

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for continued improvements and economies in telephone service

House Organs and Catalogues





Aluminum Data Booklet

Aluminum Rolling Mill Products is a ring-bound data book containing brief descriptions of the processes used in the production of aluminum. This is followed by data sheets and specification tables giving the physical and mechanical properties of wrought aluminum alloys and other forms in which the metal is supplied for commercial use. *Fairmont Aluminum Company*, Fairmont, W.Va.

Electronic Tube Data

Du Mont Reference Manual on Cathode Ray Tubes and Instruments. A loose-leaf manual contains data sheets, specifications, and explanations of the design, construction, and operation of equipment utilizing cathode-ray tubes and instruments. The first section deals with the cathode-ray oscillograph, and other sections give detailed information concerning equipment and accessories used with cathode-ray apparatus. The data sheets contain notes about installation and sheets giving specifications and tube-type comparisons. *Allen B. Du Mont Laboratories, Inc.*, Passaic, N.J.

Radio Equipment for Small Airports

Aireon 50-Watt Ground Radio Station is a 4-page colored booklet giving data about the manufacturer's type RS-1 50-watt ground radio station equipment for small airports. The equipment is offered as a complete combination radio unit ready for installation. It is reported to contain all necessary equipment suitable for point-to-point or ground-to-plane communication or as a tower control station. *Aireon Manufacturing Corporation*, Kansas City, Kan.

Transoceanic Flight Experiences

"As Normal As a Crosstown Run . . . ." is the title of a small booklet written by Bob Considine. It gives his impressions of the future importance of transoceanic air transport by contrast with conditions prevailing before and during the war. The writer forecasts a great growth in the volume of long-distance transport in luxury air liners. *United States Rubber Company.*

Automatic Vertical Turret Lathe

Man-Au-Trol Vertical Turret Lathe is a ring-bound booklet containing detailed specifications and other information concerning the Bullard Man-Au-Trol vertical turret lathe. It features the characteristics of this machine tool and outlines the improvements in operation which the manufacturer states can be accomplished through the use of the machine. *The Bullard Company*, Bridgeport, Conn.

Detecting the Causes of Airplane Accidents

Ill Winds Blow Good. Helen Call. An account is given of how Boeing service engineers help to reduce possibilities of future aircraft accidents through analysis of past mishaps. It is explained that by studying the causes of military aircraft accidents in Boeing planes, these engineers are applying the knowledge to recommendations for design preventives to eliminate such accidents in future aircraft. *Boeing Magazine*, November, 1945.

A Guide for the Proper Selection of Arc-Welding Electrodes

Arc Welding Electrodes. A new 32-page illustrated catalog is designed to guide electrode users in the selection of the right electrodes for a specific job. The catalog supplies complete data on the proper electrodes to be used for all types of work on a wide variety of base metals, and describes the approved welding procedures for each application.

Electrodes are recommended for use on mild steel, alloy steels, low-alloy high-tensile steel, and stainless steels. Additional sections deal with electrodes designed for nonferrous metals such as aluminum bronze, aluminum, and manganese bronze. Chemical analyses, specifications, and other engineering data are supplied for each electrode. *Wilson Welder & Metals Company*, New York.

Data on Cutting Fluids

Cutting Fluids for Drilling, Reaming, and Tapping. Tabulated specifications contain the manufacturer's recommendations for cutting fluids for various metals in such operations as drilling, machine reaming, and tapping. The information is listed according to the class of material to be worked, such as aluminum and alloys, brass, magnesium and alloys, bronze, copper, Monel metal, mild steels, tough alloy steels, cast and malleable iron, and tool steel. Nonmetallic materials, such as Micarta, Bakelite, fiber, asbestos, hard rubber, ebony, and molded plastics are included. *Westinghouse Electric Corporation.*

Measuring Instruments

Precise Production is a leaflet, published periodically, containing information concerning instruments for precise measurement. The current issue gives details about the new Scherr gage-block utility set that has been designed with accessories to enable mechanics to apply the accuracy of gage blocks to the work under inspection. Among other instruments included are dial test indicators provided with ball-joint backs, vernier calipers, tachometers, and Magne-Blox sets. *George Scherr Company, Inc.*, New York.

Electronic Products

Stupakoff Products for the World of Electronics describes and illustrates the manufacturer's line of equipment available to the electronics industry. It includes bases, insulators, rod and tubing, metallized ceramics, and metal-glass seals. *Stupakoff Ceramic and Manufacturing Company*, Latrobe, Pa.

News on Tensile Testing

Dillon Universal Tester, Bulletin No. 142. In an 8-page bulletin, details are given about testing tensile, compression, transverse, and shear, for a wide range of materials and all shapes of specimens. Supplementing the bulletin are specimen charts, offered to the trade on request.

For precision physical testing in a company's own plant, a Universal Tester is recommended by the maker. The tester is equipped for interchangeable dynamometers of seven capacities: 0–250, 0–500, 0–1,000, 0–2,500, 0–5,000, 0–7,500, and 0–10,000 lbs. All units are the same size and weight; overall height (without floor stand) is 37 in.; and net weight is 132 lbs. The tester is equipped for hand-wheel operation, or it can be motorized. *W. C. Dillon & Company, Inc.*, Chicago.

Plastics Company's Services

Progress in Plastics. A plastics manufacturer's 25th anniversary booklet explains the varied services now offered, which include injection molding, laminating, printing, stamping, cutting, machining, buffing, embossing, and others. An entire section of the booklet is given to the development of a new technique in thermoplastic fabrication, showing how dials of all types including those for aircraft instruments, slide rules, protractors, calculators, engineers' and architects' scales and other kindred instruments are now economi-

Start RIGHT AND YOU End RIGHT!

with WESTONS ON ALL PRODUCTION TEST-STANDS AND INSPECTION EQUIPMENT!

With the race for markets in full swing, electrical manufacturers are eliminating costly production bottlenecks by providing *uniform dependability* in testing procedure all along the line. From the inspection of purchased components right through to final product inspection, they insure accurate testing by using instruments they can trust.

And it's easy to insure *measurement dependability* at every step, because there are WESTONS for every testing need . . . including types for all special test-stand requirements, as well as a broad line of multi-range, multi-purpose test instruments. These compact, multi-purpose testers often afford new simplicity and economies in testing procedure, while assuring the dependability for which WESTONS are renowned.

Literature describing the complete line of WESTON panel and test instruments is freely offered . . . Weston Electrical Instrument Corporation, 687 Frelinghuysen Avenue, Newark 5, New Jersey.

Weston Instruments

ALBANY • ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • JACKSONVILLE • KNOXVILLE • LOS ANGELES • MERIDEN MINNEAPOLIS • NEWARK • NEW ORLEANS • NEW YORK • PHILADELPHIA • PHOENIX • PITTSBURGH • ROCHESTER • SAN FRANCISCO • SEATTLE • ST. LOUIS • SYRACUSE In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.

cally produced in all-plastic form. By substituting the speedier process of lithography for machine engraving, hairline accuracy is maintained and substantial savings are achieved. *Emeloid Company, Inc.*, Arlington, N.J.

Portable, Self-Contained Hydraulic Press

Northern Hydraulic Press. A new 20-ton motor-driven hydraulic press, self-contained and completely portable, is described in a 4-page brochure. The manufacturer states that the frame, fabricated from steel plates and heat-treated to relieve stresses, eliminates all tendency to "walk" or distortion by dividing the ram force between both sides of the press. The press is suitable for broaching, forcing, straightening, bending, die try-outs, forming, embossing, mold-try-outs, riveting, piercing, flanging, staking, upsetting, crimping, assembling, and clamping operations.

The press arch is 14 in. high by 24 in. wide. The alloy steel platen, 16 in. by 18 in. by 2 in., is ground on both sides, drilled and tapped to accommodate all setups to capacity of the press. Power stroke speed is 90 in. per min. and is easily adjusted to any length from 0 in. to 12 in., while tonnage control is effective without retarding speed of the ram. Return stroke travel is 120 in. per min., reducing idle period to a minimum. The ram is made of hard chrome-finished steel. The pressure control valve is easily set to provide accurate pressure adjustments from 1 to 20 tons, and incorporates a self-air eliminating feature designed to prevent "air locks" or pulsating and to provide smooth, steady power up to any predetermined pressure.

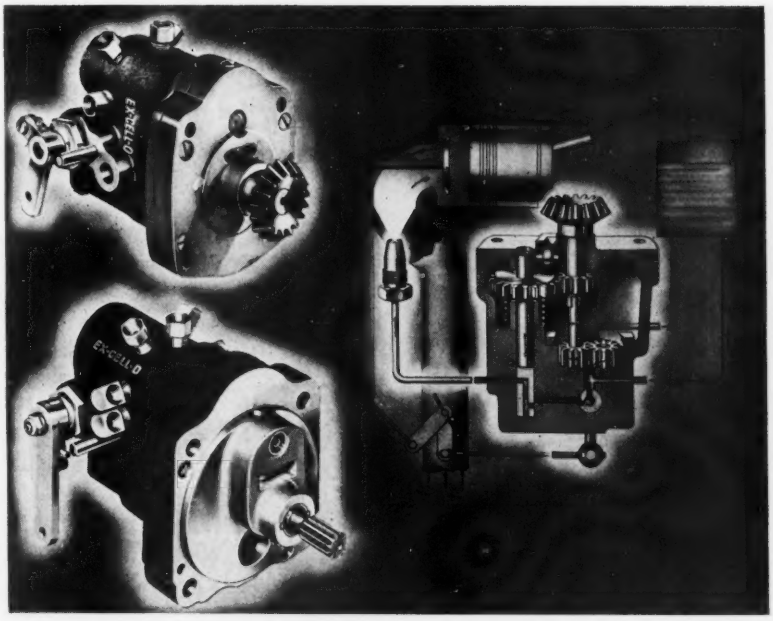
The ram is controlled by a hand lever, and its travel can be regulated, stopped at any point in its stroke or to hold on work under pressure while motor idles or is turned off. Located at eyelevel, the pressure gage is calibrated in tons of force and pounds per square inch. *Northern Tool and Machine Company*, Melrose Park, Ill.

Aluminum-Alloy Data

Allcast Aluminum Alloy is described in an illustrated bulletin. Giving the history, principal advantages, mechanical properties, and recommended applications, the bulletin states the material to be a high-quality, general-purpose aluminum alloy. The alloy is recommended by the producer for its mechanical properties and economical costs. The properties of Allcast are reported to be substantially the same as the following two types of alloys: AN QQA 376, SAE 322, ASTM SC 21,—(355 type); and AN QQA 394, SAE 323, ASTM SG 1,—(356 type). *The National Smelting Company*, Cleveland.

Air-Line Luxury

Boeing Stratocruiser is an elaborately illustrated catalog describing the luxurious accommodations and mechanical features of the Boeing Stratocruiser. In addition to photographs showing exterior and interior views of the airplane, there are numerous charts giving statistical data about its performance in commercial air-transport work and descriptions of its design and construction. The text matter and illustrations emphasize the features that have been provided to facilitate loading and unloading of cargo and passengers, and those which assist in efficient maintenance operations. Tabulated specifications give the principal measurements and other technical information about the airplane. *Boeing Aircraft Company.*



The new Ex-Cell-O gasoline injection system for four-cylinder and six-cylinder engines. Shown *upper left* is the four-cylinder pump for engines from 50 to 150 hp.; *lower left*, the six-cylinder pump for engines from 100 to 600 hp.; *right*, typical flow diagram and sectional view of the four-cylinder model injector.

Gasoline-Injection System for Small Airplane Engines

Ex-Cell-O Gasoline Injection Systems for Aircraft Engines. A descriptive circular contains detailed information about a new gasoline-injection system to replace the carburetor generally used on small aircraft engines. Designed to distribute mechanically the correct quantity of gasoline to the various engine cylinders, the system is credited with providing a positive control of the fuel-air mixture for best combustion.

Of particular interest to private owners, flying schools, and flying services are the following claims for the scheme: elimination of accidents caused by carburetor icing; equal distribution of fuel to all cylinders; reduced gasoline consumption and increased engine life through lowering of cylinder-head temperatures; increased engine power and plane speed; smoother engine performance and better idling. *Ex-Cell-O Corporation*, Detroit.

Cathode-Ray Oscillograph

Du Mont Type 248 Cathode-Ray Oscillograph. The functions, construction, operation, and applications of the Type 248 Cathode-Ray Oscillograph are surveyed in a 6-page leaflet. Complete specifications are also listed. Salient features attributed to the instrument include the following: (1) a wide-band vertical axis amplifier usable to 10 megacycles; (2) 4,000 volts accelerating potential applied to the cathode-ray tube, allowing observation of phenomena characterized by fast writing rates; (3) an extremely flexible time-base generator to display signals that heretofore required special sweep circuits; (4) a delay network in the vertical channel permitting observation of the entire wave shape of short-duration phenomena; (5) a timing oscillator for quantitative analysis; (6) a trigger output signal useful for "synchroscope" applications; (7) a convenient mechanical design that permits placing the separate power supply on the floor or on a shelf underneath the laboratory bench. *Allen B. Du Mont Laboratories, Inc.*, Passaic, N.J.

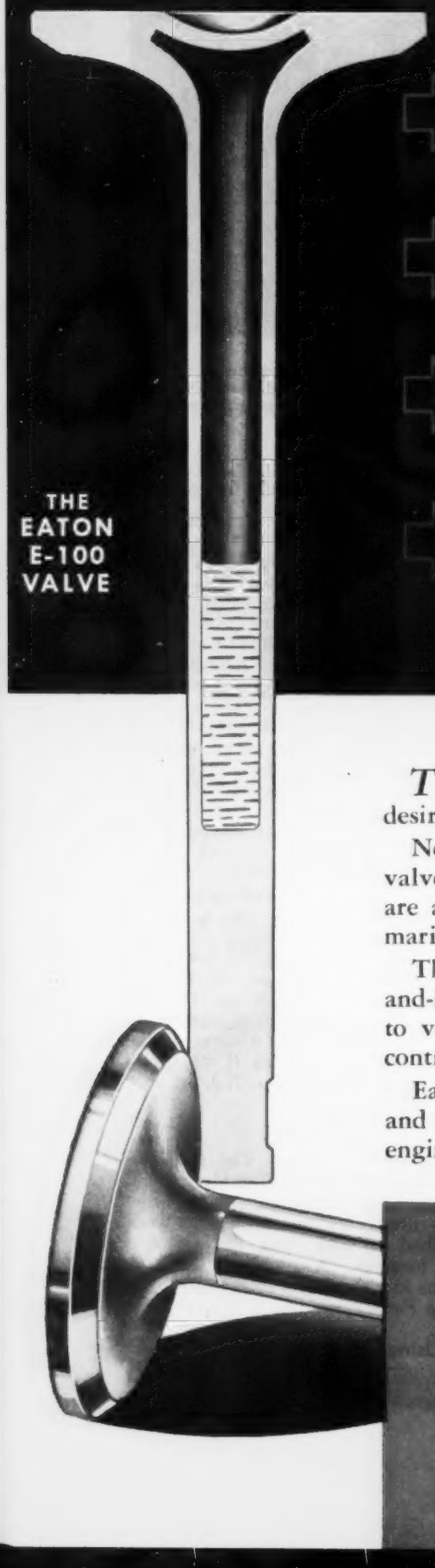
Forgings

Forgings by Kropp. The facilities, operating procedures, services, and products of a forging company are noted in an illustrated booklet. The work described includes drop, flat die, and upset forgings. A complete list of the various kinds of parts forged is shown. *Kropp Forge Company*, Chicago.

Using Parts of Surplus B-17's

There's Still Scrap in Them. Fred Hamann. Purposes for which surplus

A New Sodium Cooled Valve for ALL Internal Combustion Engines



THE EATON E-100 VALVE

- The new hollow-head design provides improved internal cooling.
- Unique head construction gives greater strength and ability to maintain normal shape at elevated temperatures.
- EATONITE — corrosion-and-heat resistant alloy—reduces face corrosion to a minimum
- Design and production economies make the E-100 valve practical for universal application.

THE NEW EATON E-100 sodium cooled valve provides the desirable combination of an *improved valve* at *lower cost.*

Now the many recognized advantages of the internally cooled valve, formerly limited to aircraft and heavy duty applications, are available to ALL engines — aircraft, passenger car, truck, marine, and industrial!

The Eaton E-100 sodium cooled valve — faced with corrosion-and-heat resistant Eatonite alloy — is adding thousands of miles to valve life, extending periods between valve servicing, and contributing to materially improved engine performance.

Eaton engineers will be glad to discuss the new E-100 valve, and present performance data which will prove interesting to all engine builders.

EATON

MANUFACTURING COMPANY

WILCOX-RICH DIVISION

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and obsolete Flying Fortresses are being purchased are recounted. Besides the utilization of these planes by schools, the use of their components for various peacetime purposes are noted. These include employment of B-17 electronic and electrical equipment for laboratories, testing and experimental shops, and other airplanes; engines for small power plants, motor launches, and pumping stations; miscellaneous items for bric-a-brac, utilities, and tools; push-pull remote control systems for actuating deflecting fins on heating and cooling systems, as well as for operating furnace controls, signal apparatus, and transoms; tubing for the construction of portable working platforms, wall racks, furniture, etc.; and hydraulic systems for conversion into supply tanks, valves, accumulators, and similar equipment. *Boeing Magazine*, November, 1945.

Study of Transportation

Questions and Answers. A booklet of 28 pages gives information in the form of questions and answers concerning national transportation policies. While the information refers to all forms of transportation, it deals largely with railroads and other common carriers, with special regard to the functions of Government in the control of such facilities. Problems connected with the development and regulation of air transportation are included in the consideration. *Transportation Association of America.*

Aspects of Civil Aviation

Max Cook's Observations. A series of booklets by Max Cook, Aviation Editor and Chief of Editorial Promotion for Scripps-Howard newspapers, referring to various aspects of civil aviation. Current issues include the following:

Let's Take a Ride with Citizen Jones gives a forecast of private flying in 1956, describing a hypothetic private airplane priced at $1,800 and showing how it is used by a typical civilian airplane owner.

They'll Cover Their Territories in Days Instead of Weeks tells about the use of a small private airplane for business transportation by salesmen and others who are required to travel in connection with their work.

America Will Place Two Cities—Possibly Four—among World's "Big 10" of Aviation. The ten leading cities in air transportation are selected, with brief comments about future air-transport operations centering in those cities. *United States Rubber Company.*

Induction and Dielectric Heating Data

Induction and Dielectric Heating Data Sheets. Tables give the radio-frequency heating rate in pounds per minute for induction and dielectric heating work. The figures cover a range in temperature rise from 200° to 2,000°F. and at powers ranging from 2 kw. to 200 kw. *Westinghouse Electric Corporation, Industrial Electronics Division*, Baltimore.

The Boeing XF8B-1 long-range, ship-based Navy fighter, powered by a 28-cylinder Pratt & Whitney R-4360 Wasp Major engine and dual-rotating propellers.

XF8B-1 Fighter

Plenty of Fight. Details are revealed about the XF8B-1, Boeing-built Navy fighter plane. With a reported speed of over 425 m.p.h., the XF8B-1 is powered by a 28-cylinder Pratt & Whitney R-4360 Wasp Major engine. Its features include dual-rotating propellers, an internal bomb bay, and range and operational capacity which are said to be equal to those of a medium bomber. The fighter is particularly noted for its versatility since, in addition to its primary function of being a long-range, snipboard fighter, it can also be used as a high-altitude or low-level bomber. *Boeing Magazine*, November, 1945.

Pneumatic Die Cushions

Pneumatic Die Cushions for Power Presses. Data sheets in loose-leaf form contain information for selecting the proper pneumatic die cushions and other equipment for use with various makes of presses for drawing sheet metal. Tables give specifications, measurements, and other recommendations of the manufacturer concerning the equipment. *Dayton Rogers Manufacturing Company*, Minneapolis.

Drilling Attachments

Angle and Flexible Drilling Attachments. Catalog No. 45 describes a group of drilling attachments designed and produced for the aircraft industry. It gives details about drilling attachments for right-angle drilling, adjustable offset and other special methods of drilling, drill adapters and other special tools, and replacement parts. *George A. Terry Company*, Buffalo.

Industrial X-Ray Equipment

Norelco Industrial X-Ray Equipment is the subject of a new 12-page booklet. Searchray Models 80 and 150 are described and specifications are given. Radiograph illustrations show X-ray applications and how the instrument reveals defects in materials. A penetration chart for various materials is included. Model 150 CF is a conveyer type, whose specifications are tabulated. Model 90 is a mobile unit for industrial use. The uses of the X-ray Spectrometer and the camera-type X-ray diffraction unit are outlined. An application-selector chart shows which Searchray unit is best suited for a given task. *North American Philips Company, Inc.*, New York.

Air-Flow Gage

Sheffield Universal Precisionaire, Bulletin No. 600–1–45. A catalog illustrates and describes the Universal Precisionaire instrument, an airflow gage that measures through air velocity instead of pressure. The instrument is reported to be widely used in the checking of all types of small and long bores to close limits. It is especially recommended for checking outside, internal, and average diameters; eccentricity; bellmouth; out-of-round; thickness and straightness; as well as the width, length, height, and depth.

With the use of this instrument, it is claimed that the human element of error is eliminated, with no special skill required of the operator. The Precisionaire is available in a wide range of amplification from 1,000 to 1, to 25,000 to 1. It is calibrated with a scale reading in increments of five millionths of an inch. *The Sheffield Corporation*, Dayton, Ohio.

Small Prefabricated Hangar

Bayley All Metal Prefabricated Tee Hangar. Illustrations and descriptive data for an all-metal prefabricated tee hangar are contained in a 4-page leaflet. It is described as a low-cost, easy-to-erect, "permanent" hangar, and its advantages to private owners and field operators are indicated. *The William Bayley Company*, Springfield, Ohio.

Arc-Welding Accessories Catalog

Airco Arc Welding Accessories, Catalog No. 130. A 12-page booklet illustrates and describes a line of accessories for all types of arc-welding machines and operations. Types of equipment covered include electrode holders, graphite electrodes, welding cable, cable

connectors, and cable lugs. Also listed are welding helmets, goggles, face shields, headgear, aprons, gloves, and sleeves. An additional section is devoted to Heliwelding equipment for welding magnesium. *Air Reduction Sales Company*, New York.

Airplane Heating System

How We Heat Our Aircraft. An explanation is given of the heating and ventilating system used by Trans-Canada Air Lines for its airplanes. The particular system detailed is one used on a Lockheed plane. *Between Ourselves*, November, 1945.

Radar Information

Bendix Radio Engineer. The January, 1946, issue of the *Bendix Radio Engineer* is given to a series of articles describing many of the important wartime radar developments. The first article, titled "Basis of Radar Engineering," by W. R. Hedeman, Jr., gives a comprehensive discussion of the fundamental considerations arising in the design of microwave radar equipment. In a series of simple explanations, the writer reviews the basic engineering involved in all radar equipment so that the nontechnical reader can understand the basic subject and the succeeding articles.

Another article, titled "Radar in Development," by George Engelbert, gives a history of the measures taken by the Allies and by the enemy in the scientific struggle for technical supremacy.

An article by H. G. Hermansen describes the type ASB-5 aircraft radar equipment. W. T. Spicer describes "The GCA Landing System," a system that permits instrument approach for the landing of any airplane carrying a two-way communication unit.

Arthur G. Norris contributes an article about mobile-pulse gunnery radar, and the mechanical design and production problems connected with radar antennas are treated by Robert J. Streb.

Ruel Colvin writes about the field testing of G.C.A. equipment and the commercial applications of radar are discussed by W. L. Webb. *Bendix Radio Division of Bendix Aviation Corporation.*

Precision Gages

Progress in the Science of Precision Measurement Recognized by the Smithsonian Institution. A report on the permanent exhibit of precision gages at the Smithsonian Institution and the proceedings of the day on which the display was inaugurated, also contains a brief outline of the history of measurement. Supplementing this are illustrations and data on four Sheffield gages, the "Multichek," the "Precisionaire," the "Visual Gage," and the "Electrichek." The first of these is described as a multiple electric gage, the second as a flow-type air gage, the third as a frictionless optical comparator, and the fourth as a commercial comparator using colored electric signal lights. *The Sheffield Corporation*, Dayton, Ohio.

C.A.A. Air Traffic-Control System

Guardians of the Skyways. H. C. Lauderback. An article on the history and functions of the C.A.A. emphasizes the traffic-control operations of the Administration. It describes not only the establishment and expansion of the C.A.A., but also the Bell System facilities which it employs for air-traffic control, and the procedures by which it operates those facilities. Observations are included with regard to the present outlook for future developments in airways control. *Bell Telephone Magazine*, Autumn, 1945.

Protect Equipment from Corrosion

Hastelloy Facing for Corrosion Resistance. A 4-page brochure describes a process for protecting chemical-plant and oil-refinery equipment from corrosion.

Two new ways are noted which have been developed for applying Hastelloy to those surfaces of equipment exposed to corrosive agents. It is explained how, for relatively small areas, welding rods made from the alloys are used to cover the area with a corrosion-resistant deposit; for relatively large areas, such as the interior surfaces of autoclaves or reaction vessels, thin sheets of the alloys are welded in place as a protective lining.

The folder gives concise data on the grades of the alloy available and the corrosive media they will resist; parts that can be faced with the material; procedures used in the facing; and methods of facing with welding rod and with sheet and plate. *Haynes Stellite Company, Unit of Union Carbide and Carbon Corporation*, New York.

Air-Line Statistics

Airlines 1945 is a booklet of 61 pages containing a statistical review of the domestic air-transport business. In addition to a general survey of the industry as a whole, with charts showing its development over a period of years and estimates projected several years into the future, individual sections review the numerous phases of the business of air transportation. Charts based on figures derived from combined financial statements of the domestic carriers show the sources and distribution of revenues and expenses, and other operating statistics.

The latter part of the booklet contains individual analyses of each of the leading domestic air-transport companies and their outstanding securities. *Merrill Lynch, Pierce, Fenner & Beane*, New York.

SWANOCEROUS? THERE'S "NO SUCH ANIMAL"... BUT

Skydyne

SANDWICH CONSTRUCTION

IS LIGHT AS A SWAN... STRONG AS A RHINOCEROS...

... A long-sought combination correctly engineered into "SKYPLY"—the miracle material available now for your aviation needs.

Light and strong, "SKYPLY" is adaptable to all types of designs because it is form-molded. This Skydyne Sandwich Construction offers a beautiful, smooth surface. Curvatures easily attained. Highly resistant to heat, cold, moisture, vibration and sound.

"SKYPLY" is perfectly suited for airplane furniture and other interior equipment. In large airliners it can be used for furnishing and finishing cocktail lounges, reading rooms, game rooms, rest quarters, frozen food compartments and storage lockers.

Get the full story of these and many other "SKYPLY" uses.

WRITE TODAY FOR OUR FREE FOLDER

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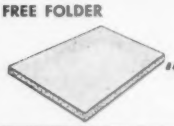


"SKYPLY"

A war-tried friend for peacetime flyers

IT'S a pretty safe bet that there's hardly a man who served in the Army, Navy and Marine Corps Air Forces who doesn't know Western Electric. During the war, Western Electric produced well over a million aircraft radio transmitters and receivers as well as vast quantities of other electronic devices for use in the air. This equipment has been a friend in need to our fighting men. They *trust* it.

Thousands of these men will enter the field of civil aviation now the war is over. They'll bring with them their faith in Western Electric equipment. And Western Electric—you may be sure—will be there to give them the finest radio and other electronic apparatus for airborne and ground station service.

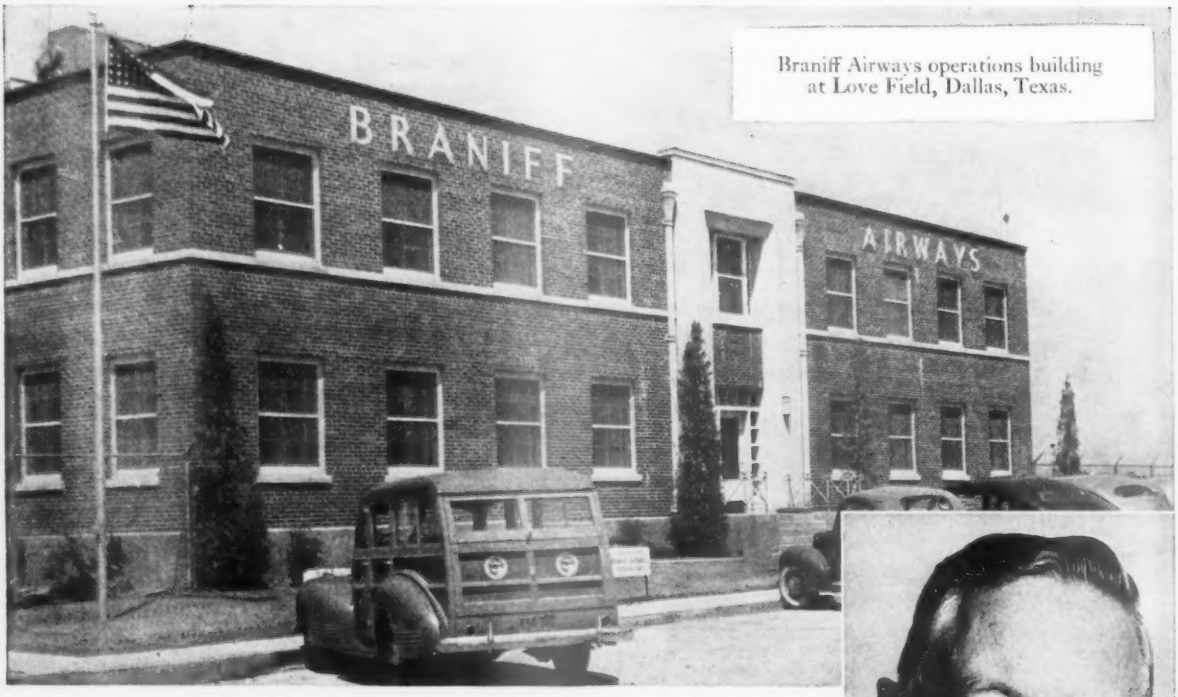
Buy all the Victory Bonds you can—and keep them.

Western Electric

Distributed by GraybaR

RADIO AND OTHER ELECTRONIC EQUIPMENT FOR A WORLD ON WINGS

BRANIFF AIRWAYS—
Oklahoma Acorn to International Oak



Braniff Airways operations building at Love Field, Dallas, Texas.

People who talk about the pioneer days being over and the lack of new fields for conquest don't know Tom Braniff and the Braniff legend.

For one of the characteristics of Braniff Airways has been that it has always kept its eyes on the ever expanding horizons of aviation.

Starting with one plane, three employees, and a 116 mile route from Oklahoma City to Tulsa, Braniff has become one of the leading air carriers of the country—3,749 miles of domestic routes, flying 28,000 miles daily, and with over 1,500 employees.

And now, the erstwhile little Oklahoma airline points toward becoming an important factor in International aviation!

People like Braniff *must* be on their toes. That's why we think it is significant that their planes use Phillips Aviation Gasoline.

We firmly believe that the best indication of the quality of a product is the kind of people who use it. Nuff said! Aviation Department, Phillips Petroleum Company, Bartlesville, Oklahoma.

T. E. Braniff, President of Braniff Airways, and one of the great pioneers of domestic airline operation.

Phillips
AVIATION GASOLINE

From the Industry

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Small Air-Expansion Turbine for Cabin Cooling

"Tornado in a Teapot" is the name applied by the manufacturer to a lightweight, midget air-expansion refrigeration turbine that has been developed for the aircraft air-conditioning field. The units now on order range from one about the size of a man's fist to one approximately 18 in. in diameter. The smallest one weighs only 3 lbs., but rates over 5 hp. and will create a 140° temperature drop at 7 lbs. airflow per min. To create such cooling efficiency the rotor operates at 100,000 r.p.m. and creates air velocities as high as 800 m.p.h.

The purpose of the cooling turbine is to pipe cold air into the cockpit or cabin of high-speed airplanes to make them comfortable for passengers and crew. The principle of the cooling turbine is to expand the hot compressed air coming from the cabin supercharger. The greater the expanding action occurring through the turbine rotor, the greater the temperature drop. Cabin supercharger air is precooled before it enters the turbine, by a heat exchanger utilizing the cold air of the atmosphere, but in most cases at least a 100°-temperature drop is still necessary. The midget air-expansion turbine, making possible great economies in weight and space, is stated to have solved this problem. AiResearch Manufacturing Company, Los Angeles.

Review of Air-Line Operations in 1945

Operations of the 24 domestic and international air lines of the United States broke all records in their history for the year 1945, according to a review prepared by the Air Transport Association of America. All categories of traffic registered gains over 1944, ranging from 57 per cent in revenue passenger-miles to approximately 39 per cent in ton-miles of express and freight.

The increase in civilian operations occurred during the period while the commercial carriers were still partially engaged in contract war operations for the Army and Navy, both in this country and overseas. The period also covered the beginning of extensive contract carrying in the redeployment of troops across the country.

The number of planes in the domestic air-line fleet reached the total of 402 as of December 15, as compared with the prewar peak of 359, with scores more in process of reconversion and other new models coming from the production lines. The overseas fleet totalled 100 planes, giving a grand total of 502, which was scheduled to exceed 600 as the year closed. But the aircraft were still insufficient to handle the steadily increasing demand for seats, particularly on the eastbound transcontinental trips, when in December the Army and Navy temporarily took over 70 per cent of the eastbound space for returning soldiers and sailors. Passengers were looking toward the early months of 1946 when the flow of planes on order will reach substantial volume and bring the total fleet to more than 1,414 planes, seating 58,284 passengers, before the end of the year 1946.

The records for 1945 compiled in the survey were based on the latest carrier reports added to a proportionate estimate for the final period on which returns had not been tabulated.

The principal categories for the domestic air lines follows: Revenue passenger-miles—3,525,619,866 as compared with 2,246,894,489 for 1944, an increase of 56.9 per cent; revenue miles—219,169,459, as compared with 144,240,440 for 1944, an increase of 51.9 per cent; revenue passengers—6,621,842, as compared with 4,575,716 for 1944, an increase of 44.7 per cent; ton-miles of mail—72,231,126, as compared with 51,143,837 in 1944, an increase of 41.2 per cent; ton-miles of express and cargo—24,505,243, as compared with 17,694,988 in 1944, an increase of 38.4 per cent.

Including estimates for the opening of new Atlantic and Pacific routes toward the close of the year, the approximate extent of the overseas operations for 1945 is revealed as follows: Revenue passenger-miles, 493,000,000; revenue miles, 32,000,000; revenue passengers, 460,000; ton-miles of mail, 4,625,000; ton-miles of express and freight, 8,336,000.

The network of air routes for the transportation of passengers, air mail, and cargo in the United States was increased by 4,034 miles. The total number of route miles which the air lines were authorized by the C.A.B. to fly reached the all-time high of 66,971. The average number of seats rose to 19.2 and the air-line personnel to more than 50,000. Fares had been reduced $4\frac{1}{2}$ cents per mile, while a reduction of 13 per cent in basic express rates was announced, effective January 1, 1946.

Still with insufficient equipment, the air lines were able to handle as much traffic as they did because of continued maintenance of the exceptionally high utilization of aircraft achieved during the war. As compared with 7 to 9 hours before the war, planes in service during the latter months of the war were flown 11 to 12 hours daily. This figure has dropped slightly on some lines, but has actually improved in others, at least two recording a $12\frac{1}{2}$-hour daily average use.

Similarly, the wartime load factor, which reached a high average mark of 92 per cent, has dropped somewhat, but three lines actually increased theirs. One line operated in the vicinity of 95 per cent of available seats filled with paying passengers, and several held over the 90 per cent mark. The international U.S. carriers were operating at better than 80 per cent load factor, with average journeys of close to 1,000 miles. Air Transport Association of America.

Instrument for Measuring Coating Thickness

The Filmeter, NRL Model 1, is reported as a new electronic instrument for measuring, rapidly and nondestructively, the thickness of paint, varnish, lacquer, ceramics, plastics, and other nonconducting coatings that may be deposited on nonmagnetic base metals. The instrument measures coating thickness from zero to 0.005 in., with an accuracy of 3 per cent of full scale, and measurements may be made on any flat surface, or on convex or concave surfaces having a radius of curvature of not less than 6 in.

The Filmeter consists of a battery-operated electronic beat-frequency oscillator contained in a 7 by 7 by 7-in. steel case. The inductance coil of one oscillator is mounted in the end of a tripod-mounted inductor and is connected to the instrument by means of a shielded rubber-covered cable. Earphones enable the operator to determine when the two oscillators are set to the same frequency. The entire instrument weighs approximately 11 lbs., and may

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be used as a portable field instrument or on a laboratory bench. American Instrument Company, Silver Spring, Md.

Injection Carburetion for Light Planes

In the new PS Series Stromberg carburetors, the advantages of injection carburetion are made available to the private flier and other users of light aircraft. Nonicing characteristics; freedom from gravity effects in dives, climbs, and banks; automatic compensation for temperature and altitude effects; and accurate predictability of fuel consumption are among the safety and performance factors claimed for injection carburetion, for engines ranging from 50 to 500 hp.

The PS Series carburetors are different from previous carburetors of the same size and power range in that they use no vented float chamber or suction pickup from a discharge nozzle placed within the venturi tube. Instead, they have a closed and pressurized fuel-feed system from fuel pump to discharge nozzle.

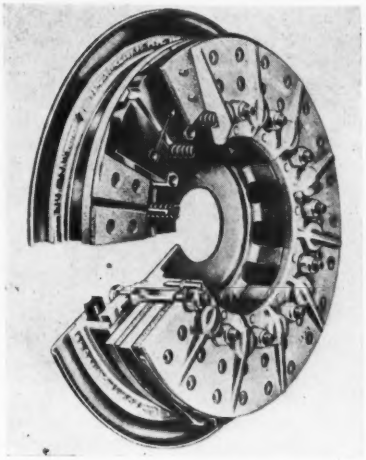
The venturi serves only to create pressure differentials for controlling the quantity of fuel. The nozzle discharge is under positive pump pressure. When the discharge fuel pressure drops below 3 lbs. per sq.in., fuel leakage past the nozzle is prevented by the closing of a spring-loaded valve. The fuel flow is automatically reduced to idling requirements when the throttle valve is moved into the idling position. Carburetor and lines are full of fuel at all times, even when the engine is not running.

These carburetors are of the single-barrel type. Since no float or gravity feed is used, any unit can be mounted for operation in an updraft, downdraft, or horizontal position. They are regularly equipped with a vacuum-operated single-diaphragm accelerating pump, and a combination manual mixture control and idle cutoff; however, automatic mixture control and power enrichment features are optional. Bendix Products Division, Bendix Aviation Corporation.

"Segmented-Rotor" Aircraft Brakes

The construction of the Bendix "Segmented-Rotor" aircraft brake is described as a new development of the disc type. The rotating members or rotors are not thin plates but are substantial discs of considerable thickness, providing a capacity for heat absorption that is said to increase the possible rate of energy dissipation of the friction members without producing excessively high temperatures in the rotors.

Each rotor is made as a series of separate segments, and not as a continuous ring of metal. These segments are flexibly attached to each other by special connecting members. A certain amount of cooling effect from air circulation between the segments, and a self-aligning effect in which the segment surfaces tend to lie flat against the face of the lined member are other advantages claimed for the segmented-rotor construction.



Cutaway view of Bendix segmented-rotor brake assembly, showing the segmented rotor between the stators. The stators carry the friction lining, which is applied as separate segments to assist in cooling and to scavenge lining dust.

The rotors are keyed to the wheel at their outer periphery, so that they turn with the wheel but have a limited free axial movement to permit application and release. The rotors are pressed between thinner discs called stators, which are faced with friction material. The stators do not turn with the wheel, but are keyed to the brake carrier; like the rotors, they have limited free axial travel.

The friction lining on the stators consists of a number of separate segments instead of a continuous ring. This provides a ventilation channel between each segment to allow air to circulate and cool the rotor. In addition, lining dust resulting from lining wear is scavenged into these channels, promoting better friction contact between the stator and rotor surfaces and reducing the required pressure for a given friction effect.

The third main structural element of the brake is the carrier, which is rigidly mounted to the support member of the strut. An annular chamber in the carrier is fitted with a piston ring and seal, providing means of hydraulically forcing the rotors and stators into contact during brake application.

The basic design has been adapted to wide variations in diameter and thickness, to suit the available space within the wheel of airplanes to which the brake has been adapted. For a given total braking area the brake may be a large-diameter assembly using possibly only one rotor, or it may be a small-diameter, thicker assembly, using several rotors. Sizes have been developed ranging from 5 in. in diameter to 31 in., using in some designs only one rotor and in others as many as four rotors.

Adjustment is effected by a simple mechanical routine that can be performed without removing the wheel. As an alternative, a fully automatic adjustment feature is offered by the manufacturer where requirements of the application warrant. Bendix Products Division, Bendix Aviation Corporation.

V.H.F. Transmitter for Private Airplanes

The new Bendix very high frequency (V.H.F.) transmitter comprises lightweight, low-cost equipment adapted to the long-term requirements of the private flier. For two-way communication at present, it may be used in conjunction with low-frequency (200–500 kc.) receivers already installed in many private aircraft. Hence, the pilot of the plane can transmit on the very high frequencies and hear ground-station replies, radio range, and broadcast on the low-frequency receiver. Later, a V.H.F. receiver and omni-directional range attachment may be added.

Channels provided in the transmitter design are adequate for the present and, at the same time, anticipate prospective additions to transmitting channels during the life of the aircraft. The new equipment includes crystals for the two channels now assigned and provides for the addition of three extra crystals for other V.H.F. channels that may be designated when the increased number of fliers causes radio congestion in the future. Furthermore, the choice of channels is easily handled by the pilot, since the equipment is so small that it fits the front panel of the aircraft and the crystal-selector switch is within easy reach.

Numerous advantages are claimed for V.H.F. air-to-ground and ground-to-air communication. Atmosphere static is almost absent, some man-made static is low, and the line-of-sight limitations are especially adapted for air communication because of reduced interference between stations beyond line of sight. Only a 26-in. vertical antenna of the rod or whip type is required, instead of a trailing wire. The transmitter does not require high power and yet provides reliable communication at distances up to 50 miles at 1,500 ft. altitude over the usual terrain, and greater distances at higher altitudes.

In addition to the V.H.F. transmitter the first Bendix "Flightweight" line of equipment for personal planes will include the following: A low-frequency range and broadcast receiver. Along with simplicity of installation and the combination of the vibrator power supply, receiver, range filter, and provision for loop directional facilities in the same unit, size and weight have been kept to a minimum. A specially designed loop antenna for direction finding, hand operated with a 360° azimuth dial. A portable double-purpose receiver for aircraft, marine, or broadcast bands, for use in or out of the plane, equipped with a built-in loop antenna enabling the set to be used as a direction finder in the plane. It will operate from either a self-contained

power pack or from 110 volt a.c.-d.c. power. A "transceiver," combining the low-frequency range and broadcast receiver and the V.H.F. transmitter. Bendix Radio Division, Bendix Aviation Corporation.

Full-View Flowmeter

The Brooks Full-View Rotameter with "Safety-Shielding" for accurate flow-rate measurement and control is designed especially for the tough services and corrosive conditions encountered in the process industries. The design is based on simple square-block end fittings, rigidly fastened together by heavy flat side plates.

"Safety-Shielding" is obtained by front and back safety-glass windows, 1/4-in. thick, held in place by stainless-steel window frames, 3/32-in. thick. All surfaces are gasketed to prevent leakage.

The Full-View Rotameter is reported to offer advantages summarized as follows: (1) It is equipped with an interchangeable "Tru-Taper" precision metering tube; (2) the space between side plates is so wide that the float position can be easily and accurately read, even from an angle; (3) the metering tube itself is easily replaced without taking the meter out of the line; (4) the end fittings are universal for connections in four directions, 90° apart; (5) the square shape of the meter makes it easy to mount on a panel with inexpensive right-angle brackets; (6) the meter parts are carefully specified and treated to prevent external corrosion. All steel parts are rust-proofed, and all steel and brass parts are given three coats of "Brookote," a special acid and alkaline resisting finish. All bolts, nuts, screws, and dowels, as well as the front and back window frames, are made of stainless steel as a standard material specification; (7) the meter is "safety-shielded" with a full, leakproof enclosure that thoroughly protects the operator and allows him to read the meter with safety.

This meter is available in sizes from 1/8 in. to 4 in., with screwed or flanged connections. With a metal tapered tube, it can be used for pressures as high as 600 lbs. per sq.in. In addition to models made of iron, brass, and stainless steel, several special materials such as Hastelloy, aluminum, lead, hard rubber, Haveg, etc., can be supplied.

The Full-View Rotameter can be obtained as a simple flow-rate indicator or with remote instrument for recording or recording and controlling the flow rate. Flow totalization also can be included. Brooks Rotameter Company, Lansdale, Pa.

Refillable Drafting Pencil

The Bruning No. 3583 draftsman's refillable pencil utilizes a new type of clutch to hold the lead firmly in a non-slip rubber grip that is designed to prevent the nicking and scoring of the lead which frequently causes breakage.

The long barrel of the pencil permits the use of any full-length standard drafting lead, from HB and 9H, with diameters of 0.079 in. to 0.70 in. The grip is knurled to provide a firm hold, and merges smoothly with the lead. An adjustable cap provides easy identification of the degree of lead used. Charles Bruning Company, Chicago.

Multiple-Purpose Stainless Steel

Stainless "W" steel is said to combine the high strength and corrosion resistance of standard 18-8 stainless steels with hardenability obtained through heat-treatment. As a result of these three properties, Stainless W is expected to find wide application in wrought and cast forms in the machinery field and is also available in strip, sheet, wire, and tube form.

Experience with this new steel during the war demonstrated that it can be treated successfully in standard equipment, and no difficulty is encountered through warping or dimensional changes in the course of hardening operations. It is readily fabricated, and high joint efficiencies may be achieved by spot welding, as well as with metallic arc, atomic hydrogen, and Heliarc welding equipment. Machinability, as shown by shop tests, is slightly better than with austenitic 18-8 stainless steel.

Preliminary commercial applications of Stainless W indicate its usefulness where strength, hardness, and corrosion resistance, all or in part, are essential. It also shows promise for application in bearings, pump valves and seats, plug valves, and other parts, as well as in the oil and chemical industries. Its strength and corrosion resistance promise further advantages for structural members.

Of the chemical elements that are ingredients of the new composition, titanium is said to give it its prime distinction, the optimum proportion of this element being found in the range of 0.40 to 1 per cent. In addition to titanium, for which columbium may be substituted at will to produce precipitation hardening, and iron, Stainless W contains carbon, nitrogen, manganese, silicon, nickel, chromium, and aluminum.

Unlike the standard 18-8 austenitic types of stainless steel, Stainless W is magnetic. It can be subjected to drawing operations and given intermediate anneal as often as desired in the course of forming and then given a thermal age-hardening treatment to develop high physical properties on the entire piece. This characteristic makes the steel a promising material for parts requiring forming and ultimate high strength in the finished piece.

The metal can be rolled into billets, bars, sheets or shapes, drawn into wire or pierced for tubing, or it may be wrought as desired to any shape or size. The finished product is amenable to heat-treatment to develop uniformly high hardness throughout large cross sections. In addition, it possesses high resistance to most corrosive media.

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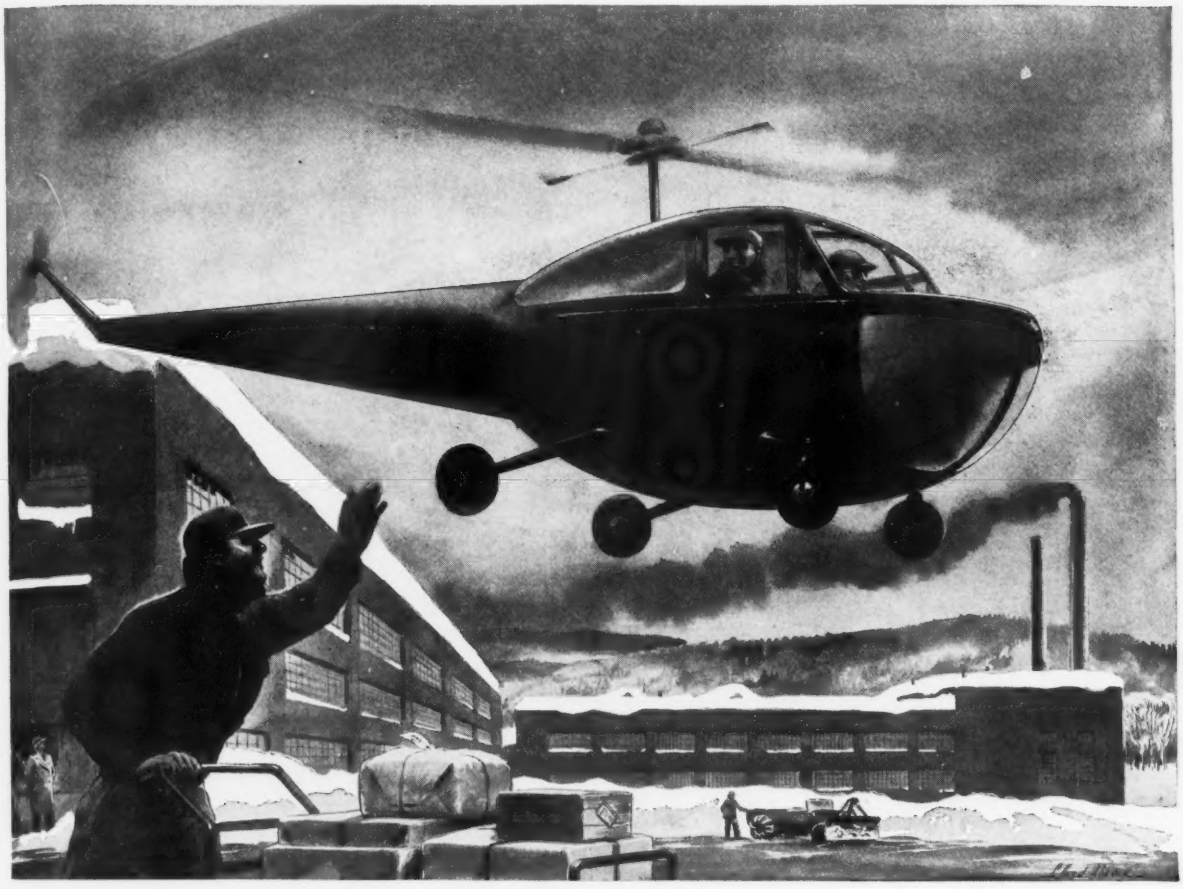

Point to Point Delivery by "The Modern Magic Carpet"*

BELL Helicopters will offer business and the public point to point delivery of people, merchandise and materials. For this versatile form of air transportation is a "Modern Magic Carpet." Helicopters can take off vertically from a small space...fly slowly or swiftly...sideways or backward...hover over and land on practically any spot where there is sufficient room for the clearance of the rotors.

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Results of 100-hour immersion tests in boiling copper sulphate-sulphuric acid solution, evaluated by bend tests and microscopic examination, showed that this steel is not susceptible to intergranular corrosion, and $3^1/_2$ years of exposure in marine, industrial, and semirural atmospheres demonstrated that it is equivalent in corrosion resistance to the more common 18-8 types. Carnegie-Illinois Steel Corporation.

New Line of Metal Planes

Four new models of personal airplanes are reported. The first two, the Cessna "120" and "140," are expected to be in volume production by March of this year and two others, the "170" and "190," will be ready by late summer. This group of personal planes will be composed of two-place, high-winged metal planes designed for the personal flier and offering many new features.

The airplanes are constructed of heat-treated 24S-T aluminum alloy. The "120" and "140" are powered by 85-hp. Continental engines and have a guaranteed top speed above 125 m.p.h. A new patented safety landing gear is one of their features. Extensive tests are reported to have proved that this landing gear offers material improvement in ground handling, especially in high winds and cross winds. Another feature of this gear is its resistance to normal ground-looping tendencies.

Listed as attributes of the "140" are a large roomy cabin section upholstered with fine fabrics, wide adjustable seats, a large full-vision windshield with no view-obstructing struts, large doors, and side windows, indirectly lighted and shock-mounted instrument panel, and manually controlled flaps giving any degree of flap desired. The metal-constructed, fabric-covered high wing carries 25 gal. of fuel in two wing tanks, permitting a natural gravity flow of fuel to the engine and eliminating the necessity for fuel pumps. Other features, such as full-sized toe brakes, steerable tail wheel, improved hydraulic brakes, and sound insulation also mark the "140."

The model "120" has the same all-metal fuselage and control surfaces, a metal-constructed, fabric-covered wing, and patented safety landing gear. However, appointments such as cabin interior trim, starter, generator, and flaps are less luxurious. The "120" is noted as being particularly suitable for students who are choosing the plane in which to take their training. With a cruising speed well over 100 m.p.h. and a range of 4 hours, it is said to be a practical cross-country rental airplane for operators. Cessna Aircraft Company, Wichita, Kan.

XSB2C-6 Helldiver

An experimental model Curtiss Helldiver is designated the XSB2C-6. Originally intended to be an improved successor of the SB2C-5, this plane has not been produced in quantity. Rapid developments in dive and torpedo bombers made it undesirable to place the "dash six" into the service-type category, and it was therefore used experimentally to test certain new features of a subsequent design of airplane.

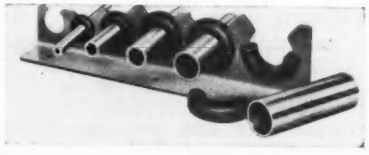
Two prototypes of the XSB2C-6 were constructed, both with Pratt & Whitney engines and Curtiss constant-speed electric propellers, but the second of the two planes had a special propeller of 13 ft. 8 in. diameter. The fuselage of the "dash six" was 20 in. longer than that of earlier SB2C's, and the landing gear was more than 9 in. longer to allow for the extra-size propellers. An interesting feature of the landing gear was a special arrangement that permitted it to be collapsed into the same area as the shorter gear on the earlier models. A high-aspect-ratio empennage with metal-covered control surfaces changed the familiar outline of the older Helldivers, as did the square-cut wing tips. Curtiss-Wright Corporation.

Propeller of the XB-42

The Douglas XB-42 is equipped with a dual-rotation propeller. Approximately 13 ft. in diameter, this electric pusher propeller has fore and aft units "divorced" or independent of each other.

On the XB-42, the dual-rotation propeller is installed on coaxial shafts but is driven by two engines through a gear box. The aft propeller of the combination is driven by one engine and the forward propeller is driven by the other engine. Each propeller has its own pitch-changing power source. Either propeller can be fully feathered, providing single-engine operation with the other power plant and propeller.

The propeller also is designed for aerodynamic braking by rotating the blades in their hub sockets to create a reverse thrust. This is said to be the first case of aerodynamic braking on a dual-rotation propeller. Curtiss-Wright Corporation.



The two-piece Double T Fairlead, consisting of the support and grommet, is designed to support lines of tubing of uniform size or a combination of sizes.

Two-Part Fair-Lead

A simplified fair-lead for electrical and other types of conduit has been developed. Composed of only two parts, the support and grommet, the device eliminates the necessity for springs and other components found in most conventional fair-leads.

Double T Fairleads are designed to support tubing of the same size or any combination of sizes. When used on gang fair-leads, any individual line or conduit may be removed without disturbance of the other lines in the same series.

With only two parts, the bracket and the grommet, this new fair-lead is light in weight, allowing for greater aircraft pay load. It is also a timesaver because all that is required to assemble is to place the split grommet over the tubing and then insert the other half of the grommet, an operation that can be done by hand. The same is true of removal of the grommet. Double T Fairlead Company, Hawthorne, Calif.

Combination Starter-Generator

Starter and generator have been combined into a single, lightweight unit in a new starter-generator construction. Since it weighs only 19 lbs., this unit is intended to give operators of small and medium-sized aircraft the convenience of a starter and generator without excessive loss of cruising range. (See photograph on page 101.)

The Eemco starter-generator couples directly to the engine crankshaft, eliminating need for gear, chain, or belt drives. A built-in torque-limiting device protects against damage from engine backfire. Brackets are available for mounting the unit on various types of aircraft engines.

The generator is rated at 500 watts, for 12-, 24-, or 32-volt systems, at 50° temperature rise. The gear reduction for cranking is 23:1 and for generation is $2^1/_2$:1. Starter torque is ample for starting four-cylinder engines up to 125 hp., and six-cylinder engines of even greater horsepower. Electrical Engineering and Manufacturing Corporation, Los Angeles.

Lower Insurance Rates and Greater Coverage for Pilots

Rates for life-insurance coverage for American civilian pilots, whether professional or amateur, and crew members, including flying personnel on transoceanic routes, have been reduced. It is also stated that student pilots and flying personnel in the armed forces are now acceptable for unrestricted insurance at liberal rates. This new liberalization of company rules governing aviation coverage follows previously announced removal of restrictions on civilian passenger flying throughout the world, irrespective of the type of plane and the conditions under which the flight is made, thus placing such air travel in the same category as train and steamship travel. The Equitable Life Assurance Society of the United States, New York.

Hydraulic Press-Type Welder

An automatic, hydraulically operated press-type welder is made in 30, 50, and 75 kva. capacities suitable for either spot or projection welding. A feature of the new machine is the inverted-type hydraulic cylinder through which welding pressure is applied. The cylinder is a part of the slide or ram, while

General Electric builds a new flight-test headquarters at Schenectady

Very soon now this combination hangar, laboratory, and workshop will be humming with electric power being utilized in equipment specially developed for aircraft—an inspiration for G.E.'s air-minded research workers. Here, new systems and equipment designed to make flying faster, safer, and more comfortable will be tested on planes of all types. For the first time, General Electric flight-test facilities will be concentrated under one roof, and near the parent plant where design engineers can rapidly check test results. Scheduled for test soon are many G-E products and systems that were designed during the war and are now being adapted for civilian use. They include the autopilot, d-c and a-c power systems, instruments, electronic and communication equipment, power apparatus, and, of course, aircraft gas turbines.

Although we will continue to develop equipment for the Army and Navy, a large part of our efforts will be devoted to civilian planes. G-E engineers, with their invaluable wartime experience, will be available to work with you on new developments and to show you what we have that may solve your design problems. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

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the piston is the so-called fixed member, its upper end being secured to the top of the welder by a heavy transverse, adjustable spring.

This adjustable heavy-duty spring serves a dual purpose. It actuates a switch initiating the timing controls and provides a quick "reaction" for a fast follow-up on the welding stroke. Welding pressure is adjusted by the hydraulic pressure regulator and gage.

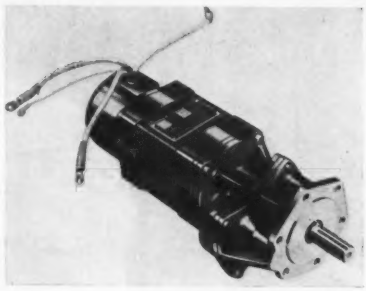
The operator has but one control to consider after the welder has been set for a specific job. That is a foot switch attached to a flexible cable which permits easy positioning for each job. A single light pressure and release puts the welder through one complete welding cycle. The speed of the weld is governed by timing controls. Automatic recycling will continue as long as the switch is held in contact. Water-cooled transformers and water-cooled electrodes are standard equipment and water-cooled horns which are available on special order are recommended by the maker for most installations.

The hydraulic press welders in the PH-1 series are available in three sizes with an overall range of "work capacity" embracing 26-gage to 6-gage steel sheets or comparable material. Federal Machine and Welder Company, Warren, Ohio.

Private-Aircraft Radio

The Motorola Navigator At-99-44 is a self-contained transmitter and receiver, incorporating the features necessary for private fliers who use the radio aids to navigation provided by the U.S. Government. These are mainly the beacon-broadcast and control-tower reception with automatic tuning, marker beacon, radio compass, and added features including a loud speaker. The range of the transmitter is approximately 25 to 30 miles, depending upon such factors as plane altitude and weather conditions. The receiver range is reported to be equal to the commercial receivers used by air lines.

Among the features of the new Motorola Navigator are the following: beam reception by push button; six push buttons that can be easily reset while in flight, without the use of tools; call letters that can be reset on push buttons while in flight, by merely rotating discs that contain the entire alphabet; automatic reeling antenna; three-band reception—beacon band (200–400 kc.), broadcast band (535–1,620 kc.), and 75-megacycle marker band. Both Fan and "Z" markers can be heard concurrently with the beam or other signals being received; intertelephone communication between pilot and passengers can be carried on while receiving radio signals; transmitter, receiver, and power supply are mounted in one unit, size $4^3/_4$ by 6 in. by $9^1/_2$ in. deep, and weighing 12 lbs. The entire radio equipment weighs only 21.34 lbs. The "Range Talk" switch places the radio receiver in automatic volume control, making it unnecessary to readjust volume control when taxiing or circling a control tower.



The Electrical Engineering and Manufacturing Corporation's combination starter-generator.

In conjunction with the presentation of the Motorola Navigator, the manufacturer also reports the introduction of the Motorola Airboy, a portable receiver weighing only 4 lbs. complete with battery. This small but powerful receiver has been especially designed for the typical aircraft antenna. It receives beacon, weather, and tower signals, and incorporates a shielded antenna and housing. Galvin Manufacturing Corporation, Chicago.

Lighter and Smaller Gyroscopes

Developments of basic importance in functional operations and design of electrically driven gyroscopes include a type of directional gyroscope recently perfected that is reported to be able to continue to function smoothly without being reset, even after a plane in which it is installed has gone through violent aerobatics. This gyroscope takes up only $3^1/_4$ by $3^1/_4$ in. of space on the instrument panel of a fighter, and weighs approximately 1 lb. less than a former type.

An advanced type of bank-and-climb gyroscope weighs $3^1/_2$ lbs., whereas an earlier instrument weighs 9 lbs. It requires only $3^1/_4$ by $3^1/_4$ in. of space on the instrument panel, while gyros of this general type now occupy more than 30 sq.in. of area.

The "universal freedom of motion" achievement in the new electrical directional gyro is explained by the manufacturer as being designed to function accurately when planes in which it is installed make banks or dives sharper than 60°. A dive or spin usually causes the conventional gyro to "tumble," in which event it will not serve as a precise directional instrument until the pilot takes time to recage and reset it.

After the conventional gyro has "tumbled," the pilot can cage it and reset it to line up with a desired compass reading, but this takes time and is stated to be unnecessary with the G-E development, since a plane equipped with this new type of directional gyroscope can plunge, climb, roll, and spin without the gyro mechanism slipping out of its precision operational status. General Electric Company.

Silicone Oils Have Useful Properties

Silicone oils that flow at temperatures as low as −121°F. without congealing are prepared with methyl silicone polymers. They are expected to be useful as hydraulic fluids for aircraft systems in the operation of flaps, doors, and landing wheels. Silicone oils also can be used in fine instruments and as a dielectric fluid in capacitors and transformers.

Methyl silicone polyemrs, in the form of elastomers, produce a silicone rubber that does not decompose at +400°F. or harden at −67°F., and maintains its elasticity over long periods of time at the high temperature of 302°F. under load.

With regard to other silicone products, it is stated that some methyl silicone resins have been found which undergo no decomposition or disintegration over a period of years at 392°F. and maintain their dielectric strength for long periods even at 572°F.

The small change of viscosity and other physical and electrical properties with temperature may prove to be among the most important properties of the new products. The unusual properties of the organosilicon polymers and their intermediates have suggested many uses for these materials, and the amounts that are now available have found ready application. General Electric Company.

Instrument for Studying Rotary Motion

Developed for the study of airplane propellers under actual operating conditions, the Rotascope is reported to be the first instrument of its kind which allows the continuous viewing of a rotating object at any point on the perimeter.

The device is stated to be an answer to the scientific problem for an optical system capable of "untwisting" the light rays of rotating equipment before they are recorded by the human eye. It eliminates the rotary component of motion but shows any flutter or vibration of the moving part, thereby making it possible for scientists and engineers to make a thorough study of the rotating parts of machinery. Engineers can actually see what happens to any of the rotating objects while under the "strain" of operating at thousands of revolutions per minute.

Lowest speeds as well as speeds up to 2,000 r.p.m. can be studied with the Rotascope, and special designs of the instrument can be made for the study of higher speeds. The instrument may also be used in industry for the study of angular motions, particularly those of low angular velocities. General Electric Company.

Magnetic Hardness Tester for Gaging Small Ferrous Metal Parts

For rapid, accurate gaging of hardness of small, ferrous, metal parts, a new magnetic hardness tester provides

Many an aviation pipe dream has become a reality because of the increasing power and efficiency of aircraft engines. Helping to make this possible has been the tremendous progress in aviation gasoline. Oil refiners appreciate the worth of Ethyl antiknock fluid in helping them make aviation fuel that permits modern engine performance.

Ethyl Corporation

Chrysler Building,
New York City

ETHYL
BRAND OF ANTIKNOCK COMPOUND
ETHYL CORPORATION
TRADE MARK REG. U.S. PAT. OFF.

Manufacturers of Ethyl fluid, used by oil companies to improve the antiknock quality of aviation and motor gasolines.

a convenient "go-no go" hardness gage, and simplifies inspection of such parts as electric-instrument pivots and shafts, small steel balls, and other parts too small to be production-tested with mechanical-type hardness testers. It also permits checking of hardness in large sheets, or lengths of steel wire, through the comparison of random-selected small samples.

The tester, 6 in. long, $3^1/_2$ in. wide, and 7 in. high, consists of an alnico bar magnet set in an adjustable, soft-iron frame, which permits the air gap and the field strength to be set at the correct value for testing pieces of different size, whose dimensions are between $^1/_{16}$ and $^1/_2$ in. A knurled thumbscrew locks the air-gap adjustment, and a brass block for positioning the specimens is mounted on the base of the tester, a little out of the direct line of the magnetic field. A two-way level is attached to the base to show when the tester is properly positioned, and a pair of brass tweezers is furnished for handling the specimens.

The operation of the magnetic hardness tester is based upon the correlation of hardness and coercive force in magnetic materials. It checks pieces of unknown hardness against a specimen of known hardness by comparing, in a simple, mechanical test, the relative strength of the magnetism produced in the test pieces and in the standard specimen, under the same conditions of magnetization. This test will distinguish differences as little as two points on the Rockwell C scale, and does not damage the piece tested. General Electric Company.

Electrical Industry Contributions in 1945

In a brief review of the activities of the electrical manufacturing industry in 1945, comments are included about the contributions of the industry to the advancement of aviation and its related fields.

Specific contributions of the electrical manufacturers to aviation are listed as the production of reaction-propulsion power units for such jet-propelled aircraft as the Lockheed P-80 Shooting Star and others; combination-type aircraft power plants incorporating a jet propulsion unit and a conventional reciprocating engine, as exemplified by the Ryan Fireball; and a power plant combining a gas-turbine drive for a propeller with the reaction-propulsion assistance from the thrust developed by the jet. Improvements in the turbosupercharger, automatic engine-control equipment, and the turbosupercharger regulator were other accomplishments connected directly with the propulsion of aircraft.

Electric motors for the control equipment of aircraft were refined and their application was greatly extended, while new and better generators were developed to supply power for the operation of aircraft auxiliaries. Great advancements also were recorded during the year in electric instruments for installation in aircraft and for the numerous devices used in building, testing, and maintaining them. The industry contributed extensively to the development and application of electronic equipment for use in manufacturing, flying, and servicing aircraft, particularly with respect to radar and other navigating instruments, radio transmitters and receivers, and other communication devices.

The electrical manufacturers produced large quantities of electrical apparatus and machinery for the Government plants in which the work on atomic power was performed, and contributed in many ways to the research and development that made possible the atomic accomplishments of the year. It is indicated that there are broad possibilities of the further development and application of atomic energy for power generation in industry and transportation, including aviation.

In addition to the foregoing, great progress was reported in the development, production, and use of electrical apparatus of many kinds employed in the aircraft-manufacturing plants for facilitating the industrial processes involved in the production and assembly of aircraft and their components. General Electric Company.

Weld-Spatter-Resistant Compounds

Two new weld-spatter-resistant compounds, No. 9951 and No. 9952, have been specially formulated for use in the welding field wherever weld spatter is undesirable and must be avoided easily and economically.

Supplied in powder form, ready to be mixed with water, the compounds are identical in performance. The only difference between them is that the No. 9951 is nonadherent and can be readily removed with an air hose or a dry cloth, while the No. 9952 is semi-adherent but can be quickly and easily removed by use of a damp cloth or a direct stream of water.

A feature of these compounds is that the surface of the work, even if slightly oily, does not require wetting before they can be applied. Another feature is that a special ingredient in the compounds eliminates the necessity of a water-soluble binder in order to obtain adhesion. Therefore, since the compounds are inert and cannot burn, they are smokeless.

The manufacturer states that 1 gal. of either compound will adequately cover 450 to 750 sq.ft. of work, depending upon the thickness with which the compound is applied. General Electric Company.

Axial-Flow Turbojet Engine

A new axial-flow turbojet engine has been developed for military and civilian planes, and is expected to achieve improvements in aerodynamic design and fuel consumption, opening the way to greater range and more economical operation of airplanes.

Known in the Army Air Forces as the J-35 and known industrially as the TG-180, this engine is long and light in comparison with reciprocating engines. The frontal area of the axial-flow G-E Jet is stated to be less than that of reciprocating aircraft engines now used on large airplanes.

Sustained high speed is possible for planes powered by these engines, since they function most economically when running at nearly full throttle, with the result that the cruising speed of an axial flow G-E Jet is practically top speed. When functioning at that rate, it will drive a plane further on a given amount of fuel than it will at lesser speed. General Electric Company.

Aircraft Gasoline Tank Made of Nylon

Development of an airplane gasoline tank made of nylon, which weighs only a fraction as much as any tank heretofore devised and which has particular qualities of wear and safety, has been reported.

The new tank weighs slightly more than 0.07 lb. per sq.ft., compared with metal tanks which weigh 0.5 lb. per sq.ft., bladder-type tanks which weigh almost as much, and bullet-sealing fuel cells which weigh about 2 lbs. per sq.ft.

To indicate the lightness and flexibility of Pliocel gasoline tanks, as they are called, it is disclosed that an empty 100-gal. tank can be folded and compressed, without damage, to the size of a woman's handbag.

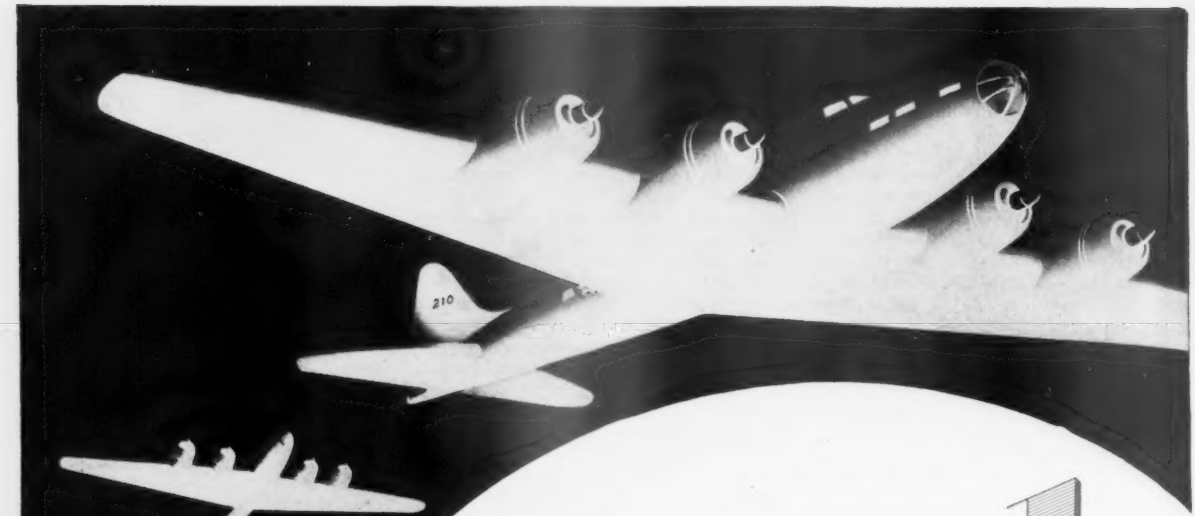
At present the Pliocel fuel tanks are being used experimentally by 18 commercial, military, and private airplane builders on 30 types of craft. The tanks are usually folded for insertion through small access doors in the airplane structure, then snapped into place by glove-type fasteners.

Developed after 8 months of research, the fuel tanks are said to be potentially more crash-resistant than metal tanks because of their flexibility. In addition, they are entirely resistant to the passage of highly volatile fuels. The Goodyear Tire & Rubber Company.

Portable Crane

A new line of portable cranes is suitable for handling loads where overhead lifting equipment is not available. The cranes, made of welded steel, weigh less than half as much as previous models. Two-speed operation is provided by means of a single or double cable for light or heavy loads. Adjustable extension handles give additional leverage for extra heavy loads. A self-locking worm mechanism holds the load with safety at any point.

The cranes are now available in all models of 1 to 3-ton capacity. Greater strength, lighter weight, and safer operation are claimed as their outstanding features. The Hill Acme Company, Cleveland.



Unnamed, Unknown, Unsung but Still... 1st

After compiling more "firsts" than any of its combat sisters, the Honeywell test bomber, a B-17 Flying Fortress, has been officially grounded, never to fly again.

Stripped of turrets, guns and armor plate, the bomber, designated as 41-19210, but called 210 by its crew, is being transferred to the University of Minnesota's Aeronautical Engineering Department by ATSC after serving more than three and one-half years in Minneapolis as the dogship for a long list of automatic control devices jointly developed by technicians of the company and the Air Forces.

The Honeywell test ship was the

1. **First bomber equipped with an electronic automatic pilot**
2. **First plane equipped with an automatic leveling bombsight**
3. **First plane equipped with a steering motor tying in radar with flight control**
4. **First plane equipped with an electronic formation stick**
5. **First plane equipped with electronic, four-engine turbo supercharger control and many firsts in blind landing equipment.**

From these accomplishments you can readily see how Honeywell creative engineering can and will help you improve performance of all types of aircraft.

The Honeywell program includes a complete flight research department, test aircraft, and thousands of dollars worth of testing equipment. In addition, trained application engineers, with broad experience in the use of aeronautical and industrial controls, will collaborate with aircraft manufacturers and airlines in developing the most practical equipment for each specific problem. Their work includes consulting service and flight testing at the customer's plant. These men can help you in the application of Honeywell equipment to your control problems.

•

Minneapolis-Honeywell Regulator Co., Aeronautical Division, 2670 Fourth Avenue So., Minneapolis 8, Minnesota. Branches and distributing offices in all principal cities.

CREATIVE ENGINEERING

Makers of the famous M-H Electronic Autopilot, used on AAF four-engined bombers

MINNEAPOLIS Honeywell CONTROL SYSTEMS

Indicator for Warning of Critical Air Speeds

Aeronautical development leading to flight speeds even greater than those already attained by experimental military aircraft of the jet and rocket propulsion type is expected to be assisted by quantity production of a new maximum-allowable air-speed indicator known as the Army-type F-4. The instrument is intended to warn pilots as their planes approach critical speeds in the compressibility zone which are a threat to control and structural limitations.

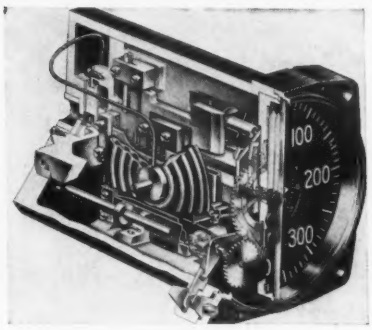
Originally conceived by the Air Technical Service Command of the A.A.F. and the Bell Aircraft Corporation, the idea was translated into actuality by engineers of the Kollsman Instrument laboratories of the Square D Company. The F-4 safe air-speed indicator has two hands, a red one indicating the maximum allowable air speed, and a white pointer showing the plane's indicated air speed. A pilot need give only a fleeting glance to see that the speed registered by the white hand never exceeds that indicated by the red hand.

In designing the instrument two problems were apparent. First, compensation had to be made for the fact that the speed of sound decreases as altitude increases and, therefore, the speed limit of the plane depended on its altitude. Secondly, allowance was necessary for design variations which would permit some planes to fly faster than others before entering the zone of critical speed. The result was a mechanism capable of automatically and continuously computing the ratio of the airplane's air speed, at varying altitudes, to the speed of sound, and an adjustment that could be set according to the speed at which shock-wave phenomena would occur on a specific airplane. Kollsman Instrument Division of Square D Company.

Two-Way Radio for Private Planes

A new, light, compact, two-way radio navigational instrument, named the "PX'er," is only a little over 6 in. square, and weighs less than 15 lbs. with all its accessories. It is intended to supply the private flier with ample facilities for radio communication with the control tower for traffic instructions on landings and take-offs; contact with range-station broadcasts and beam signals; and, with the addition of an AML loop, it will serve as an aural-null direction finder.

The two main features of the PX'er are the simultaneous range filter and the built-in provisions for aural-null direction finding. The transmitter output is approximately 5 watts. It has been designed for operation from a 12-volt battery. The receiver and transmitter drain on the battery is only 4.5 amp., while standby operation with microphone switch requires only 6.0 amp. It transmits on 3,105 kc. and receives all of the range stations and control towers from 195 to 405 kc.



Cutaway view of the new Kollsman F-4 maximum-allowable air-speed indicator, designed to warn the pilot of approaching critical air speeds.

The small power pack can be installed any place where there is space and to the best advantage of the c.g. conditions in the aircraft. The size of the pack is $4^3/_8$ in. by $4^3/_4$ in. by 5 in. It operates from the aircraft battery supply. The set uses six automobile-type radio tubes so that it does not require any special shock mounting, and operates efficiently on a fixed antenna, although a trailing antenna is suggested by the manufacturer for best results in cross-country operation. Lear, Incorporated, Grand Rapids, Mich.

Refrigeration Unit for Cabin Cooling

A small 115-lb. air-expansion turbine refrigeration unit will keep cabin air of the Lockheed Constellation transport plane within the 75°F. temperature zone of maximum passenger comfort even though ground temperatures are as high as 100°F.

The original design of the Constellation included refrigerating equipment, but during the war the military versions of the air liner were built without the refrigerating units, as a wartime economy. The entire refrigerating system has been redesigned and is being included in new commercial models of the airplane.

Even in the cold of the upper atmosphere, where summer temperatures are often below freezing, it is necessary to cool cabin air to maintain the desired 75°. At 300 m.p.h. friction resulting from speed of the airplane through the air alone causes a temperature rise of 15° to 20°. The pressure system adds more heat to air introduced into the cabin. Radio equipment, electric motors and lights, and the sun's rays all add to the heat of the cabin.

The new refrigerating system is powered by the superchargers that supply air for cabin pressurization. This air not only powers the air-turbine refrigerator but is cooled in the process and introduced into the cabin for pressurization.

This arrangement makes possible substantial economies in weight and space. The cooling unit measures only 18 in. high, 27 in. deep, and 37 in. long. Lockheed Aircraft Corporation.

The P2V Navy Patrol Plane

The Lockheed P2V was designed for the Navy, to perform the function of a peace-patrol plane to guarantee law and order. Reported to have carrying capacity and range comparable with those of bombers such as the B-17 and B-24, the P2V is the first land-based plane designed for the Navy for the specific job of patrol, and is reported to have greater range, higher speed, and heavier armament than any patrol and search bomber previously developed.

Squadrons based at Guam, for example, could make routine searches over an area including Wake Island, Tokyo, Manila, and Rabaul, on New Britain. Operating from Manila, P2V's could range over Singapore, Shanghai, and Hanoi in French Indo-China. Performance capabilities of the P2V are designed to enable it to fly nonstop observation missions of more than 5,000 miles, a range sufficient to fly from Pearl Harbor to New York, or from Tokyo to Seattle without refueling, or to fly nonstop from Washington to Moscow. It is intended to perform equally well at high and low altitudes. It can skim the ocean on search and rescue missions, or it can fly at an altitude of more than 4 miles for accurate photographic and radar mapping.

Having a speed of more than 300 m.p.h., the P2V can be used, in event of surprise attack or unexpected uprising, as an attack bomber. Various combinations of bombs, torpedoes, rockets, and depth charges can be carried, and in addition it can fire sixteen 5-in. high-velocity aircraft rockets from underwing launchers. Six 20-mm. cannon are fixed in the nose to give forward firing power, and twin-mount 0.50-cal. machine guns in the top turret and in the powered tail turret cover all angles of approach to the plane.

The new plane has a wing span, overall length, and bomb capacity closely comparable to those of the Army's B-17 bomber. Its two R-3350-8 Wright Duplex Cyclone engines, the same as those used on the Lockheed Constellation and the B-29 and B-32 bombers, develop a total of 4,600 hp. Hamilton-Standard propellers are used, 15 ft. 2 in. in diameter, and having shot-blasted blade shanks. The Lockheed P2V has a range of 3,500 miles with full load and more than 5,000 miles with bomb-bay tanks. The range is 50 per cent greater than that of the B-17, 20 per cent greater than that of the Navy's Privateer, and comparable to that of the B-29.

A nylon plastic shell that affords extra protection for the self-sealing fuel tanks is one of the numerous new developments. Another distinguishing feature is the varicam tail, a Lockheed-developed mechanical device for varying the camber of the horizontal tail surface. This facilitates trimming the plane in flight to allow for shifts in weight and center of gravity. Improved Fowler flaps give aileron control

Now it can be Told

Vital Navy Radar equipment protected from damaging moisture by Chandler-Evans Protek-Plugs!

In the recessed cover of an access door on this Navy Model SO Series Radar Transmitter Receiver Unit are two Protek-Plugs. Another, shown on the side of the case, serves as an indicator to tell when those inside should be removed and fresh ones inserted.

On this operating panel of Navy Model SO Series Radar equipment are shown the ends of two Protek-Plugs. These are also merely indicator plugs, telling when those within the unit have reached the saturation point.

Small, inexpensive little products — but CECO Protek-Plugs did a big job during the war. These transparent plugs are filled with silica gel, a substance with amazing adsorptive powers. Treated with a blue dye, they gradually turn pink as they reach saturation, indicating exactly when they should be replaced by fresh ones.

Vital parts and equipment are thus constantly protected from rust and corrosion-producing moisture. Radar equipment like that illustrated above . . . airplane engines being shipped overseas . . . precision binoculars, and other vital equipment made use of Protek-Plugs. It is safe to say that peacetime uses for these devices will be as many and varied as their wartime duties.

CECO

CARBURETORS
FUEL PUMPS
PROTEK-PLUGS

CHANDLER-EVANS CORPORATION

WEST HARTFORD 1, CONNECTICUT, U. S. A.

even with flaps extended. Dural nacelle armor plate protects the power plants.

A midwing monoplane, the P2V has a wing span of 100 ft., overall length of 75 ft. 6 in., and overall height of 28 ft. 1 in. The wing surface is 1,000 sq.-ft., ailerons measure 66 sq.ft., elevators 39.3 sq.ft., and rudder 38.4 sq.ft. Power loading is 16.1 lbs. per hp. with maximum gross weight of 58,000 lbs. Wing loading is 58 lbs. per sq.ft. with maximum overload. The plane has a tricycle landing gear, and carries 2,000 lbs. of radar equipment. Pilot, co-pilot, radio operator, navigator-bombardier who handles the radar bombing gear, radar operator, and two observer gunners make up the crew. Facilities for crew comfort include an all-electric galley and sleeping accommodations. Lockheed Aircraft Corporation.

Experimental Army Airplanes

Details have been revealed recently about two experimental Lockheed warplanes—the Chain Lightning, a modification of the standard P-38 fighter; and the XP-49, Lightning fighter with Continental engines in place of the Allison engines used in production models, and with a pressurized cockpit. Both the Chain Lightning, designated by the Army as the XP-58, and the XP-49 closely resemble the standard P-38 fighter.

The XP-58 has a maximum gross weight of 38,000 lbs., more than twice as heavy as a P-38. Its wing span is 70 ft. and length of 49 ft. 6 in., both dimensions a third larger than those of the Lightning. It carries a two-man crew, including a tail gunner occupying a rear turret. Engines are the 24-cylinder Allison W type developing 3,000 hp. each.

The XP-49 has large spinners and enlarged cowling to house the Continental engines, but the revised internal construction has not changed the similarity of overall lines to those of the P-38. Lockheed Aircraft Corporation.

New, quick-opening engine cowling, announced as standard equipment for the Lockheed Constellation.

The Martin XPBM-5A, a modification of the PBM Mariner, described as the largest amphibian airplane built to date.

Quick-Opening Engine Cowling

An engine cowling that opens like an automobile hood will give air-line mechanics access to power plants of the Constellation transport in 2 min. and will reduce ground handling time greatly.

The new cowling arrangement consists of four main panels. The two side panels, hinged to the upper section, can be removed quickly without unfastening any hinge bolts or pins. Both upper and lower panels are hinged to the main structure of the engine nacelle. Quick-opening, flush-type latches hold the panels in place.

While mechanics are working on an engine, the panels are simply swung out of the way, just as an automobile hood is raised. When both upper and lower panels are swung aside, the entire engine is accessible for maintenance work. No support members or braces interfere with tools or vision.

The upper panel houses the carburetor air-induction system, and the lower panel has a duct for the oil-cooling air. A single electrically operated cowl flap is included in each of the two side panels. The cowling will be installed as standard equipment on Constellations scheduled for delivery late next Spring. Lockheed Aircraft Corporation.

30-Ton Amphibian Version of PBM

Described as the largest amphibian airplane built up to the present, a 30-ton craft listed as XPBM-5A is a modification of the Martin PBM Mariner. The new craft is designed to serve a dual purpose. It will be able to fly from runways, using a modern tricycle landing gear with forward wheel folding up into the hull, the main wheels making a 180° arc to rest in wells built into the hull sides.

The need for an amphibious PBM was brought about by unusual weather conditions encountered by the Navy in such places as the Aleutians and Iceland. In these subarctic climes the ordinary hazards of wartime flying were increased many fold. Patrol flights were long and arduous; in a land where the weather was unpredictable, a landplane might take off in bright sunshine, complete the patrol, and return to find the runway completely fogged out—a situation in which a boat would have a better chance of getting down safely. There are hazards to all-boat operations, also; frequently, the air is much colder than the water and a boat taking off gathers a dangerous amount of ice on wing and tail surfaces.

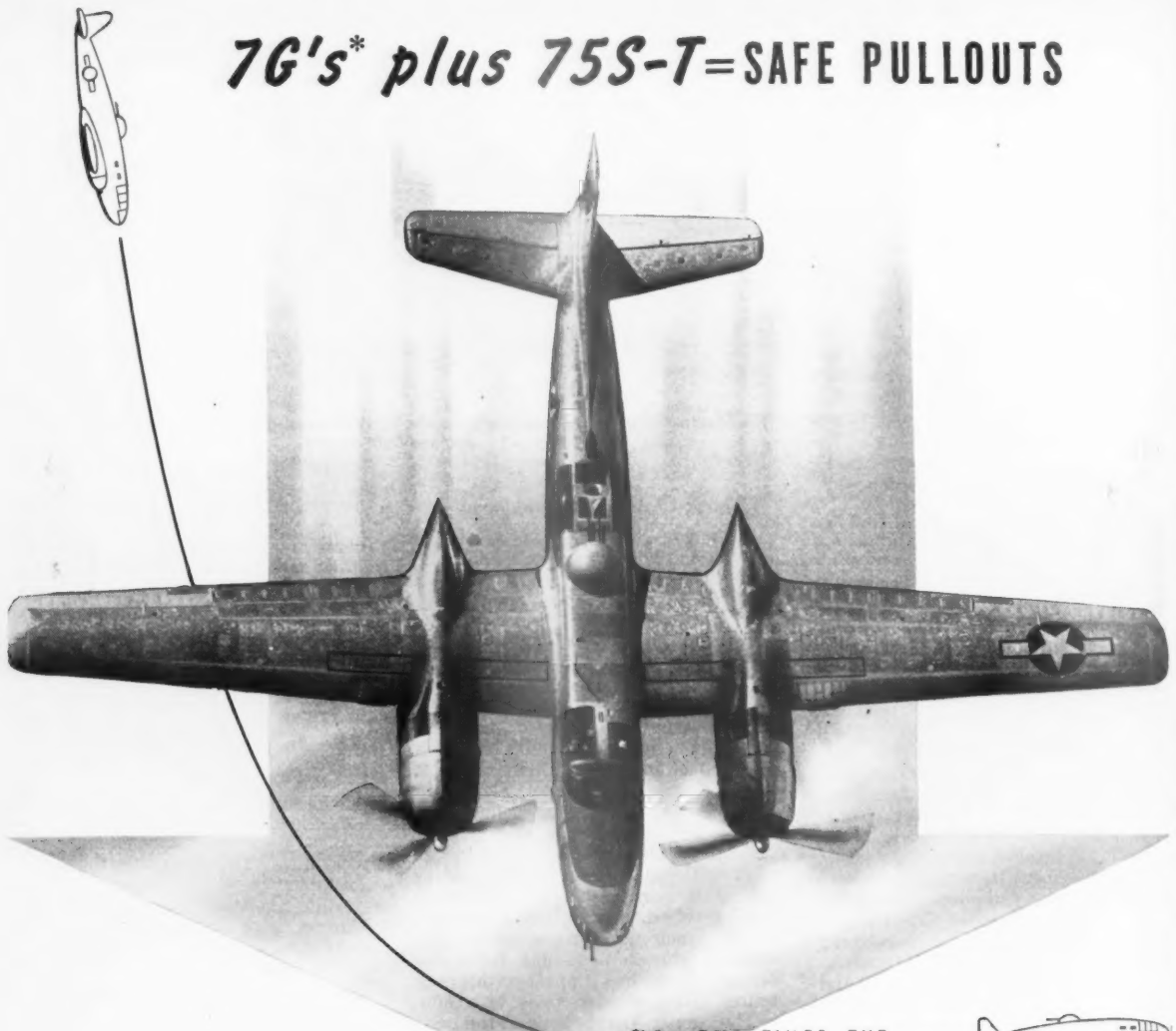
Again, a large part of the Navy's task was air-sea rescue. Boats speeding to the scene of a torpedoing or a forced landing could alight in the water to pick up survivors, take off and return to a runway, taxiing to a waiting ambulance.

Although the basic airplane is a Mariner, with the best features of that craft retained, it was necessary to modify certain basic subassemblies. The flight deck and tail assembly are identical with those of the PBM-5; however, the hull section forward, where the landing gear is located, has been completely redesigned, with bulkheads reinforced to carry the loads, new floor frames, and stronger beams.

The landing gear is a special Martin design. The main wheels operate on a single steel shaft or trunnion; hydraulic power hoists and lowers them, and automatically operated locks hold them in position. Although the landing gear (and the consequent hull redesign) is exceptionally strong, only 4,500 lbs. have been added to the total weight of the aircraft. Despite this addition, the airplane is expected to have a gross take-off weight of 64,000 lbs. on land, 56,000 lbs. on water.

Amphibious Mariners are expected to play a great part in Navy, Coast Guard, and Army operations during peacetime. Naval men will use them for patrolling and air-sea work; they will be able to aid the Coast Guard, with its frequent calls for quick rescue tasks. With the Army's war-developed overwater operations, amphibious Mariners should be as valuable to that branch of the service as to the Navy and Coast Guard. The Glenn L. Martin Company.

7G's* plus 75S-T=SAFE PULLOUTS



Pull-outs of 7G's impose terrific strains on wings.

In Douglas A26 Invaders, with wing spar caps of Alcoa 75S-T stepped extrusions, the safety factor was well in hand. This amazingly high-strength aluminum alloy, increased static test results to 115% of rated load . . . without a weight penalty.

This is just one of the many airplane applications for Alcoa Alloy 75S-T, where highest strength with accompanying light weight are major design factors. For information on the amazing characteristics of this alloy and where it can be effectively employed in your airplane, write ALUMINUM COMPANY OF AMERICA, 2142 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

"Floating Piston" Features New Hydraulic Valve

The new Gerotor 4-way hydraulic valve has a "Floating Piston" design that is intended to improve valve-operating efficiency and ease of operation. The design permits close fitting of the piston in the valve bore and gives maximum sealing ability. The valve stem is supported in its bearings in the valve covers without any influence on the piston fit in the valve body.

Minimum leakage is gained not only from this close fit of the hardened and precision-ground piston with the valve bore, but also from an "O" ring seal design that prevents exhaust oil from leaking past the piston stem. Likewise, an "O" ring seal on the valve covers gives positive sealing without a gasket.

The valves are suitable for oil service with pressure up to 1,500 lbs. per sq.in. and can be furnished for 2,500 to 3,000 lbs. per sq.in. service. They are offered with four types of action: standard, spring return, spring centered, and ball detent. Five piston designs are available, with six types of operation: hand, foot, cam, solenoid, oil pressure, and air-pressure operated. They are made in sizes 1/4 in., 3/8 in., 1/2 in., 3/4 in., 1 in., 1 1/4 in., and 1 1/2 in. Gerotor May Corporation, Logansport, Ind.

Automatic-Feed Electric Soldering Iron

The Eject-O-Matic, a patented, automatic-feed, electric soldering iron, is trigger-operated and ejects a measured amount of solder from a reel concealed in the handle. A special retracting feature prevents the melting of excess solder on the heating tip. The actual amount of solder deposited each time the trigger is pulled is regulated by a micrometer adjusting wheel mounted in the handle of the iron, easily accessible to the operator's thumb. If during the course of a job more or less solder is required, a touch of the wheel changes the amount ejected.

The pistol-grip handle is made of molded Bakelite and is provided with a two-section, slide-on cover. The shorter section provides access to the loading chamber; the longer section houses the feeder mechanism. The latter also incorporates a long grooved channel through which solder is conducted to the heating tip.

A tube containing the heating element extends from the handle. A replaceable tip is grooved to guide the molten solder to the exact point of application. This tip is noncorrosive and is especially designed for fast heating. Excess heat is dissipated before it can reach the handle by nine graduated cooling vanes located on the tube near the handle.

The Eject-O-Matic is provided with a special stand. When resting on this stand the iron can be moved forward through an angle of 45°, thus providing a firm foundation for the operator when doing fine work. The trigger extension is available to enable the operator to work with the iron on the stand, leaving both hands free to hold the work. Multi-Products Tool Company, Newark, N.J.

Glider with Auxiliary Power

Successful test flights of an auxiliary powered glider called the "Bumblebee" were reported recently. The two-passenger glider is equipped with a four-cylinder, two-cycle engine developing 16 hp. at 3,500 r.p.m., fed by a 3-gal. gasoline tank. It has a 1 1/2-hour fuel capacity at full throttle and will cruise at 75 m.p.h.

On take-off the glider will climb at about 38 m.p.h. to an altitude suitable for soaring. Another of its features is the fully retractable tricycle landing gear, operated manually by the pilot. The nose wheel is steerable, with miniature shimmy dampeners and a lock. The two rear wheels have special cam action, so that they may be embedded in the fuselage at the proper angle. They also have independent, internally expanding brakes which facilitate taxiing on the ground.

A strut-braced, high-wing monoplane, with dual controls, the Bumblebee has a 47 ft. wing span, and a wing area of 168 sq.ft. Its overall length is 23 ft.; height, 5 ft.; weight (empty), 465 lbs., with 350 lbs. allowed for two passengers; engine weight, 44 lbs. Horizontal tail surfaces are 16 sq.ft., vertical tail surfaces, 12 ft.

One of the noticeable design characteristics is the conventional single-boom tail. Except for this boom, of hollow dural, the glider is made entirely of plywood, with a molded shell for the pilots' nacelle.

The instrument panel contains a conventional throttle, choke, mixture controls, altimeter, air-speed, and sensitive rate-of-climb indicators. There is also a magneto ignition with impulse starter so that the engine will not kick back, and a ratchet wire starter mounted on the crankshaft enabling either pilot in the cockpit to start the engine.

The prototype was flown with a conventional wood propeller but that is to be replaced by an adjustable-pitch, full-feathering propeller on future models. Diameter of the propeller is 42 in. Provided on the front end of the glider is a conventional glider hook for towing if desired.

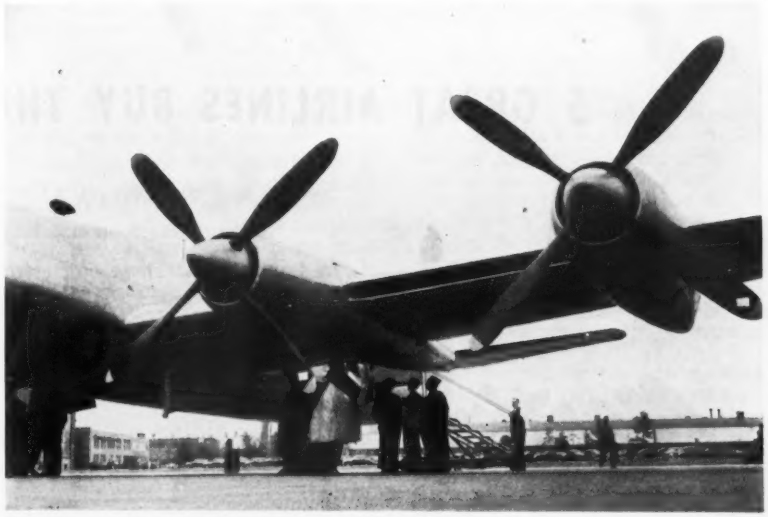
The Bumblebee is credited with entailing a minimum storage and maintenance expense. Wings and tail surfaces may be disassembled and the entire glider hauled on a trailer between the pilot's own garage and the airfield. Nelson Aircraft Corporation, San Fernando, Calif.

XF-12

It is now disclosed that Republic Aviation Corporation has had under development for the past 2 years, for the Air Technical Service Command, a high-speed, long-range photo reconnaissance aircraft, known as the XF-12. The new craft is nearing completion and will be ready for test flight in a few weeks.

While exact performance figures were not made public, it was stated that the XF-12 is designed to operate in upper altitudes at speeds comparable to that of wartime fighter planes. Powered by four Pratt & Whitney Wasp Major engines, each developing 3,000 hp., the XF-12 is expected to meet A.A.F. demands for long-range performance necessary to carry out reconnaissance and photographic missions such as were not possible up to this time.

The plane has a wing span of 129 ft. 2 in., and its length, from nose to tail, is 98 ft. 9 in. The tip of the vertical stabilizer is nearly 30 ft. from the ground. Each engine nacelle approximates the size of the fuselage of a P-47 Thunderbolt, and two General Electric turbosuperchargers are provided for each engine. The four Curtiss



The Republic XF-12 high-speed, long-range photographic reconnaissance plane. Note the air-intake ducts in the leading edge of the wing. Engine-cooling fans are attached to the propeller spinners.

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Wright propellers are of the four-bladed type and measure 16 ft. 2 in. from tip to tip.

The A.T.S.C. specifications call for three camera stations, one vertical, one split vertical, and one trimetrogron; and one vertical view-finder. The XF-12 will carry complete radio and radar equipment, armor plate, and flash bombs for night photography. Dark-room equipment for storing and loading film is included. Republic Aviation Corporation.

Antivibration Mounting Uses Steel Spring

In a new model of the Robinson Vibrashock Unit, a departure has been made by carrying the principal load by means of a stainless-steel spring of special design, with three-way freedom of movement and built-in, three-way limiting snubbers providing a resilient stop to limit heavy shock loads. This method of mounting is stated to be less vulnerable to cold, heat, and humidity.

Vibrashock units are available in three standard sizes and a wide range of load capacities to provide the aeronautical industry with efficient, economical antivibration mountings for radio, radar and communication equipment, instrument panels, instrument-landing equipment, seats, berths, engines, auxiliary power units, and many other installations in commercial and private planes. Robinson Aviation, Inc., Teterboro, N.J.

Additional Details of Recent British Aircraft

Additional information about recent types of British aircraft has been disclosed. The latest to be removed from the secret list are the Handley Page Halifax A.IX transport, the General Aircraft Hamilcar powered glider, the Taylorcraft Auster V and the Fairey Firefly F.Mk. IV naval reconnaissance fighter.

To meet the requirements of the R.A.F. and Airborne Forces, Handley Page produced a new version of the Halifax bomber, designated as the A.IX. This aircraft can operate as either a bomber or a transport. Designed and equipped primarily for duties with the Airborne Forces, the A.IX normally carries a crew of six—pilot, navigator, wireless operator, air bombardier, flight engineer, and rear gunner; and 16 fully equipped paratroopers and two dispatchers, whose duty it is to control the dropping of the men.

The rear gun turret, a Boulton Paul type 'D', carries two 0.50-cal. guns, whereas formerly 0.303-cal. guns were fitted. Serving as a paratroop exit, the main entrance door is situated in the floor of the rear fuselage immediately forward of the rear bulkhead. This door, operated by a lever on the port side, opens inward and backward, providing an aperture approximately 33 in. by 59 in. On the roof of the fuselage above the dropping position is mounted a signalling panel that is operated by the air bombardier. Two rails are provided for the attachment of the static lines and to facilitate the quick dropping of paratroopers. The static lines are retracted by means of a winch mounted on the rear spar.

A streamlined container having a capacity of 8,000 lbs. may be fitted into the normal bomb bay of the aircraft for carrying military equipment. If required, long-range tanks can be fitted in place of the container, thereby considerably extending the range of the machine.

The four Bristol Hercules XVI radial air-cooled engines of 1,675 hp. each give a maximum speed, with full load and at 22,000 ft. Range, with full load at economical cruising speed, is 2,080 miles and the maximum load is 8,699 lbs.

The Taylorcraft Auster V is a development of the light plane that was used extensively for Army cooperation and observation work throughout the war. A modification of the Mark IV, it will be useful as an ambulance, for picking up mail, laying cables, or other purposes. The chief differences between the Mark V and the Mark IV are that the former has a modified tail unit and has a full instrument-flying panel. To accommodate this panel, the fuel tank has been redesigned for clearance. Also, provision is made to fit radio in the Mark V, the passenger's seat beside the pilot being removed for this purpose.

This latest Auster is powered by a 130-hp. Lycoming "Flat Four" 0-290-3/1 engine, giving a maximum speed in level flight at sea level at 2,800 r.p.m. and with total weight of 1,700 lbs., of 130 m.p.h. The cruising speed at 1,000-ft. altitude is 112 m.p.h. Cruising range at 1,000 ft. is 220 miles and absolute ceiling is 18,200 ft.

The new mark of the Fairey Firefly, the F.Mk. IV, shows an increase in speed of 40 m.p.h. over the Mark III. The newest version of this naval reconnaissance fighter is designed for day and night fighter duties. Each of the two prototypes is powered with a Rolls-Royce Griffon 72 engine, giving 2,300 hp. at 14,000 ft. Production models will have the Griffon 74.

The versatility of the day fighter is increased by the number of different loads which can be carried under the wings. In addition to the standard armament of four 20-mm. cannons, it has a number of attachment points under the wings where jettisonable loads can be carried. Outboard, in front of the ailerons, two 45-gal. drop tanks can be carried, which have been proved by wind-tunnel and flight tests to have only a slight effect on performance. Inboard there are two more jettison points on each side, on which 45-gal. or 90-gal. tanks can be slung, together with a bomb load. A 1,000-lb. bomb or a load of rocket projectiles can be carried on each side.

As a night fighter, one of the outboard tanks is replaced by an equivalent-shaped fairing which houses radar equipment. Flame damping is introduced by interchangeable side panels and alternative exhaust troughs. The maximum speed of the newest Firefly, flying at 14,000 ft., is 386 m.p.h. and economical cruising speed is 220 m.p.h.

The General Aircraft Hamilcar glider was built to carry a military load of 17,500 lbs. and have a total weight of 37,000 lbs. It now has engines to improve the take-off of the glider-tug combination, to increase operational radius of action, and to make it capable of independent flight at light load.

Powered by two Bristol Mercury XXI engines, the glider's total weight has been increased to 47,000 lbs., still carrying a military load of 17,500 lbs. The engines are simplified so as to require only the throttles in the cockpit; the mixture controls are interconnected with the throttles, and cowling gills have been removed in favor of a permanently flared skirt to each cowling. Propeller controls are not required as the engines are fitted with two-blade fixed-pitch wooden propellers of extremely light weight.

The span of the Hamilcar is 110 ft., length 68 ft., height 20 ft. 2 in., and gross wing area 1,658 sq.ft. Cargo capacity is 1,440 cu.ft. At full load and towed by a Halifax III tug aircraft, the towing speed is 150 m.p.h. Take-off distance to clear a 50-ft. obstruction is 1,040 to 1,750 yards, according to the total weight of the tug plane dictated by range requirements. The rate of climb at sea level is 435 to 730 ft. per min. according to the weight of the tug.

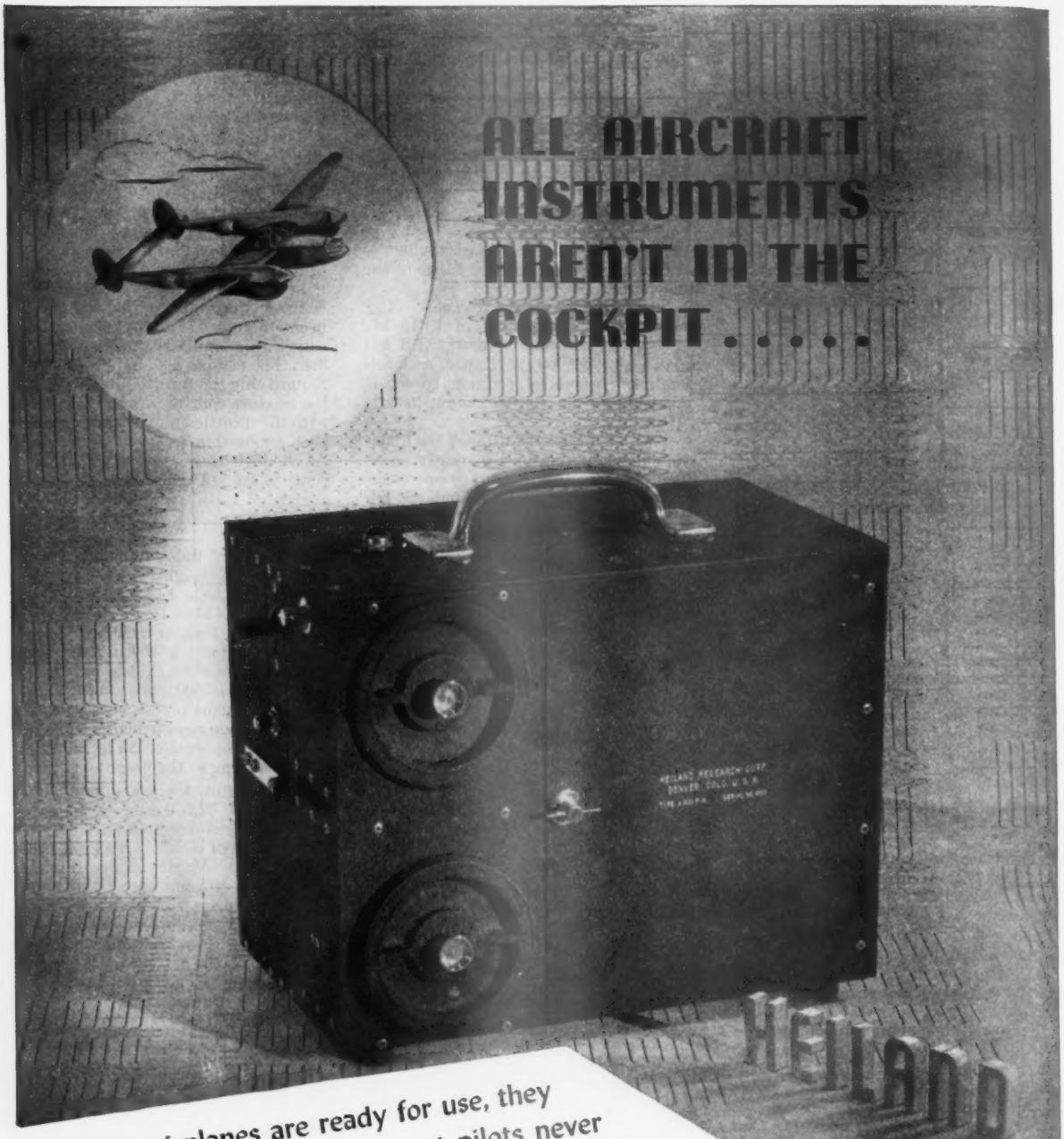
In solo flight, the take-off weight of the glider is 32,500 lbs. Distance to clear a 50-ft. obstruction is 1,385 yards and the rate of climb at sea level is 395 ft. per min. Maximum speed is 145 m.p.h. and cruising speed 120 m.p.h. Service ceiling is 13,000 ft. With 400 gal. of fuel, the still-air range is 705 miles, and with extra tanks making a total load of 860 gal. of fuel, the range is 1,675 miles. The Society of British Aircraft Constructors.

Business-Promotion Slide Film

Sixteen suggestions for successful airport operation have been dramatized in a slide film titled *It's Good Business at Your Airport*. Prepared as part of a business-assistance program for airport operators and aircraft dealers, the film shows how the operator may make the most of the postwar period of increasing private flying.

By means of contrasting photographs and recorded narration, the film gives a simple visualization of the right and wrong way to operate an airport. It also offers helpful hints to show that the right way can be accomplished as easily as the inefficient way. An eleven-point questionnaire on essential points of operation provides the individual dealer with a standard against which to measure his own airport and to help him to see his airport as the customer sees it.

The 31-min. slide film emphasizes how to promote postwar private avi-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ation—who is expected to fly, what type of trip will be made, and what airport services will be most in demand by these flying customers. The narrative also explains cooperative advertising and merchandising plans that are available to the operator at a fraction of the cost of undertaking these promotions individually.

The airport-operations section of the film covers all aspects of the business from aircraft mechanical repairs, complementary services, airport upkeep, painting and landscaping, to written records of customers' service orders on specially prepared blanks. Standard Oil Company of New Jersey.

Plastic Strips for Airplane-Interior Trim

Tenite plastic strips are aiding in the conversion of the Lockheed C-69 Constellation from an Army transport to a luxurious passenger craft. Throughout the interior of the plane, lightweight Tenite trims the walls, windows, luggage compartment, and joints of overlaid veneers to finish and "dress up" the cabin interior. Five different types of extruded strip are used. Plain white or colored extrusions finish all seams, joints, and retaining strips.

Application is simple. The strips are cut to proper length, placed along the seams or joints to be covered, and forced into the cracks. Because of the flexibility of the strips, they are as easily applied to square or rounded corners as to straight seams. Once inserted, they are held by a barbed flange that prevents their working loose under vibration. Extrusions to cover the aluminum retaining strips in the inner cabins are snapped into place in a forced fit which is made possible by the toughness and resilience of the plastic. No adhesives or other fasteners are used, and painting or polishing is unnecessary. Tennessee Eastman Corporation.

Horizontal Miller with Heavy Flywheel on Spindle

The No. 2 medium horizontal miller is especially designed for horizontal milling of medium-sized and smaller parts. It combines strength with accuracy and sensitivity of operation and control. Among the engineering features is the incorporation of a heavy flywheel mounted on the spindle inside the column, giving uniform transmission of power to the cutter.

The cutter spindle is exceptionally large in diameter and is mounted on large double-opposed Timken bearings in front and straight roller bearings in the rear. Large precision gears with greater tooth area are made of hardened alloy steel. Multisplined shafts rotate on taper roller bearings.

For ease of operating convenience, the No. 2 medium has front and rear directional control of all power feeds. These controls are actuated in the direction of desired table, saddle, and knee movement. Power rapid traverse also has front and rear control. They provide finger-tip control from either the front or rear position. Manual feeds have large dials with convenient graduation in thousandths. A single-lever feed selector provides quick, easy selection of 18 speeds and 18 feeds.

The feed transmission, built into the knee, has hardened alloy-steel gears and multisplined shafts. Twelve changes of feeds are available through a rotary feed selector and a high-low series lever located on the side of the knee. An improved ram-type overarm is large and has dove-tail bearing on the column with locking means on front and rear of column. A pilot wheel located on the side of the column enables the operator to position the overarm in any desired position.

The No. 2 medium horizontal has a table size of 50 in. by 10 in. A 5-hp. motor provides adequate power for every type of cut. Longitudinal range is 28 in., cross feed 10 in., vertical feed 17 in. Eighteen speeds are variable from 30 to 1,500 r.p.m.; 12 feeds from 0.5 to 36 in. The machine is available with plain or universal saddle. The universal saddle permits the table to be swiveled 45° to the right and 45° to the left. Net approximate weight of the machine is 4,000 lbs. Standard equipment includes a set of wrenches, pulleys and belts, style A arbor support (hole size $^{23}/_{32}$ in.), style B arbor support for $2^{1}/_{8}$ in. sleeve, outer brace, draw-in bar, coolant system. Van Norman Company, Springfield, Mass.

Hole-Punching Units

Wales Type "BL" hole-punching units are independent and self-contained. The punches, dies, stripping guides, stripping springs, and guide buttons are the component parts. The holders automatically align punches and dies and keep them aligned. Nothing is attached to the press ram. The only function of the ram is to depress the punch. Every setup of these units is ready to start punching with the first stroke of the ram, without adjusting units, punches, or dies.

The same group of units may be set up on T-slotted plates or mounting plates, in stamping presses and on rails, or T-slotted plates in press brakes. This interchangeable use of the same units permits setting up unlimited numbers of patterns and putting the sets into operation the same day that a pattern is released for production.

Combination setups for hole-punching and notching are possible with Type "BL" units because the closed-position height on these hole-punching units is the same as the maker's Type "N" notching units. This feature of uniform height requires only one adjustment of the press ram regardless of how many hole-punching patterns are placed in operation.

Type "BL" units are available in seven holder widths with maximum punch diameter of 2 in. for use with metal up to $^{1}/_{8}$ in. thick. Wales-Strippit Corporation, North Tonawanda, N.Y.

Gas-Turbine Auxiliary-Power Units

The prime mover of a new kind of aircraft auxiliary electric power plant is a small gas turbine. Connected to the turbine is a 24-kw., 30-volt d.c. generator, and a 2.5-kva. 120-volt, 400-cycle generator. Also required is a 5-hp. motor for starting the turbine, a voltage regulator for each of the generators, and a 1,000-amp. relay to prevent current from flowing from the battery to the d.c. generator. Other accessory power plants being studied will provide 400-cycle power at 40 to 50 kva. for a.c. powered airplanes, and will include small d.c. generators for auxiliary 28-volt d.c. power. Westinghouse Electric Corporation.

Delicate Dynamic Balancing Instrument

Older types of dynamic balancing machines able to measure unbalance effects having amplitudes of 20 millionths of an inch are too crude for many present-day high-speed rotating parts. This is particularly true of the wheels of gyroscopes in bombsights, navigation instruments, and stabilizers. The rotors of superchargers also require extremely accurate balance. To balance such parts so they may function properly and without failure, it is necessary to reduce the amplitude of vibration caused by unbalance to a fraction of a millionth of an inch.

To meet these requirements for extremely accurate balance, engineers of the Westinghouse Electric Corporation and the Gisholt Machine Company cooperated to apply a superior type of amplifier to the fundamental principles of the Dynetric Balancer. The resulting machine, the Microbalancer, can measure and locate unbalances that produce vibration amplitudes as small as $^{1}/_{4}$-millionth of an inch. The instrument measures and locates the unbalance effect produced by a weight of one-millionth of a pound at a $2^{1}/_{2}$-in. radius on a 10-lb. rotor. A piece of lint or a moist fingerprint weighs that much.

Many of the rotating parts that must be balanced to this order of accuracy are normally supported on ultraprecision ball or roller bearings. Before these parts are balanced, the almost infinitesimal defects in the ultraprecision bearings produce vibration effects in addition to the vibration effect produced by the unbalance. These random vibrations attributable to the minute defects in the bearings frequently are 100 times as great as the desired minimum vibration of the balanced rotor. By use of extremely effective filters superimposed on the filtering characteristics of a wattmeter, the desired separation of vibration effect was obtained.

The device being balanced is made to provide a reference voltage without any contact being made to it. A phototube is focused on a small spot of contrasting color on the rotor. The weak synchronous pulse from the phototube is amplified to a usable reference voltage

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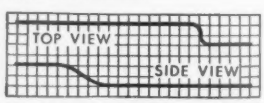
Make sketches of top and side views of installation. Use regular graph paper and indicate unit of measure.



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wave, which is used to provide synchronous flashing of a stroboscopic lamp, by means of which the unbalance is located without random shifting caused by speed changes or antifriction bearing disturbances. This perfect reference wave is also used to supply the current coil of the wattmeter that is used to measure the unbalance. Westinghouse Electric Corporation.

Landing-Strip Identification

Guidance for a pilot approaching a busy airport, as to what runway to land on and in which direction to come in, is given by a "traffic light" that provides markers in the shape of a large cross and arrow outlined in bright colors at the end of each runway. The cross, of which each diagonal is 90 ft. long, is outlined in red-colored neon lamps. The arrow, 100 ft. long from end to point and 35 ft. across the head, is made of green-colored zeon lamps. When a landing is to be made at night, all the red crosses are set to flashing, while the green arrow at the landing end of the strip in use is lighted.

Each cross consists of twelve pairs of high-intensity cold-cathode lamps physically similar to the new long fluorescent lamps. Each arrow consists of ten pairs of lamps. Each pair of lamps consumes 225 watts, so that sufficient light is produced to make the markers visible even under adverse atmospheric conditions. Westinghouse Electric Corporation.

New Approach Light

For use with radio "blind landing" systems, a new searchlight-type approach light for airports uses a 19-in. reflector-lens system with a special 250-watt lamp. The main beam has over 1,250,000 candle power and is aimed directly along the path of the incoming plane. Auxiliary "fan beams" of over 100,000 candle power reach from the ground to an angle far above any plane on the radio beam.

Mounted in long rows on each side of the approach zone, and spaced 500 ft. apart in the rows, the new lights set up brilliant walls of light on each side of the approaching plane. As each approach light has about the same candle power as an airway beacon, the twenty-five 100-ft. rows of light provide over $^1/_2$ mile of direct visibility in foggy weather. Westinghouse Electric Corporation.

Colored-Light Landing-Angle Indicator

The approach-angle indicator is designed to assist a pilot to land his plane at night, enabling him to glide in on a beam of colored light. This unit (two of which stand at the end of each runway) projects three colored beams toward the approaching plane. The top beam of the light band is an amber beam 8° thick. It indicates that the plane is above the proper approach angle. The middle one is a 2° green beam, indicative of correct approach. The bottom one, 6° deep, is red, significant of the danger of too-low approach.

All beams are 16° across, or wide, and each color is sharply defined. The overlap is so slight that if an observer at 100 ft. inclined his head sidewise he would see one color—and only one—with one eye, and a different color with the other eye. Even at 1 mile the zone of color transition is only about 4 ft. wide. The secret of such beam fidelity is the lens system. The unit comprises a reflector, a 100-watt single-plane filament, and a series of five clear lenses and three color filters. The lens system not only provides sharp color separation but also achieves a 10-to-1 light (color) magnification.

To prevent mistaking the red or the green beams for obstacle markers or other airport markers, the beams are flashed by a simple mechanism. A vane is tipped across the light beam to cause the interruption. But instead of rotating a vane by a motor and a gear, a small high-speed motor drives a cam, which forces the vane to move 90° into the light path, against a light spring. By variation of the cam, the timing of the light can be controlled. Actually it is arranged to produce only one-third darkness. This is ample for unmistakable interruption, and allows a longer period of "light-on," providing the eye effect of greater brightness. Westinghouse Electric Corporation.

Library Facilities of the Institute of the Aeronautical Sciences

To serve Institute members and others in the aeronautical industry, the Institute of the Aeronautical Sciences offers the facilities of:

The W. A. M. Burden Library
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The Paul Kollsman Library
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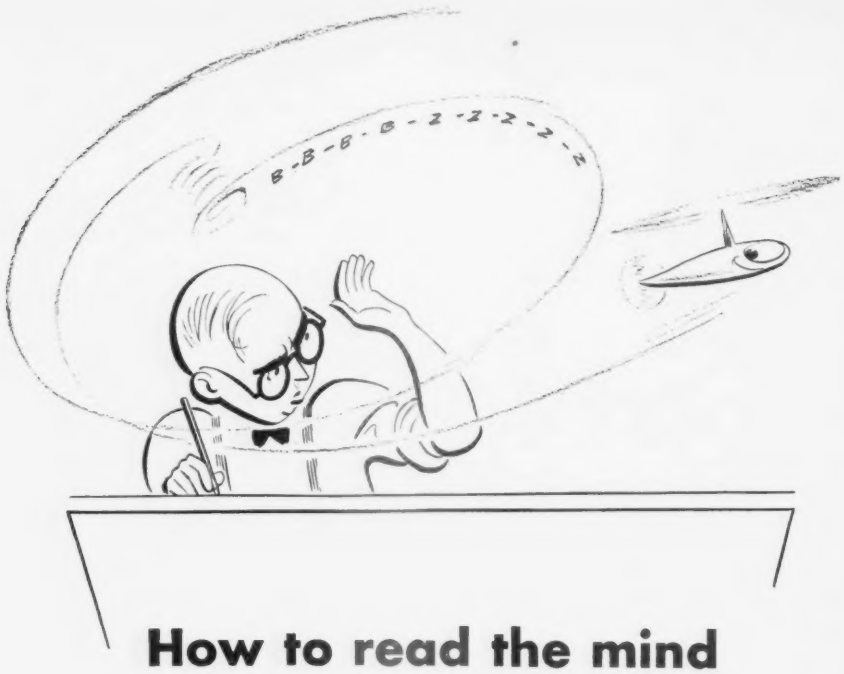
New York 21, N.Y.

This library loans books without charge to members and others in the United States over eighteen years of age. Full information will be sent on request.

The Pacific Aeronautical Library
6715 Hollywood Boulevard
Hollywood 28, Calif.

This is a service and reference library for West Coast organizations. Full information as to its facilities will be sent on request.



How to read the mind of an aircraft designer

The thing to remember about reading an aircraft designer's mind is that it doesn't read from past to present, the way an average mind does, but from the future to the present. He starts with a set of ideal flight characteristics and works back to what can be done this year or next.

Learning to think that way, too, is how Fafnir came to be the largest supplier of ball bearings to the industry.

Take the helicopter, for example; it takes a lot of Fafnir Ball Bearings . . . some of them as unconventional as the helicopter itself. Like the blade retention duplex ball bearing which has to handle the tremendous thrust load of the rotor blades or the bracelet-like dual ball bearing for the rotor cyclic pitch control. Others, such as the "K" Series and rod end bearings for the control system, the bearings for the rotor shaft and the gear box and transmission, are adaptations of standard Fafnir Ball Bearings.

These Fafnirs have one thing that makes them better for their "tomorrow job" than any other bearings. Fafnir Engineers were working with the designers . . . in the same direction, ahead into the future. Which explains why more Fafnirs are used in the aircraft of today and tomorrow than the bearings of all other makes combined. The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR

BALL BEARINGS

For Aircraft